THE UNIVERSITY
OF MICHIGAN
OCT 24 1961
ENGINEERING

NUCLEAR SCIENCE ABSTRACTS

Volume 15 Number 18A
Abstracts 23162–24626

September 30, 1961

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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

23162 (CEA-1883) LES METHODES DE CONTROLE DANS l'INDUSTRIE DE L'URANIUM. (Methods of Control in the Uranium Industry). Jean Prugnard (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 17p.

Presented at the 32nd International Congress on Industrial Chemistry, Barcelona, October 1960.

In its broad sense, the supervision applied to uranium refining is not appreciably different from that found in ordinary industry. It should be noted, however, that the main preoccupation will be exceptional purity in the final product, and constant vigilance must be directed toward conforming with the accepted safety standards in such an organization. The various problems at issue and the steps taken to solve them are discussed. (auth)

23163 (JPL-TR-32-114) SELECTION OF POWER REQUIREMENTS FOR NUCLEAR-ELECTRIC SPACECRAFT MISSIONS. Jerry P. Davis (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). May 24, 1961. Contract NASw-6. 16p.

A method is presented for bracketing propulsion power requirements for spacecraft missions consistent with specific launch vehicle boost constraints and anticipated state-of-the-art reactor-conversion system development. A Mars orbiter mission is taken as an illustrative example of the basic approach. Having selected launch vehicle, payload, and flight time, the distribution of powerplant and propellant weight is discussed. Curves are presented which indicate the minimum power requirement for the mission, the power range which affords maximum powerplant design flexibility, and the powerplant specific weights which must be attained to accomplish the mission. The interplay between mission requirements and powerplant development is indicated. An indication is given that a nuclear electric plant in the power range of 100 kw(e) propulsion at a specific weight in the range of 35 lb/kw(e) can accomplish a useful Mars orbiter mission in a reasonable flight time and delivering a useful scientific payload. Data are presented for two Jupiter missions. (auth)

23164 (RM-2624-AEC) CAVITY EXPLOSION CALCULATIONS FOR THE COWBOY PROGRAM. H. L. Brode (RAND Corp., Santa Monica, Calif.). Aug. 5, 1960. Contract AT(11-1)-135. 43p.

Calculations are reported which correspond to the cavity explosions of the COWBOY program. These were spheres of high explosive ranging from 20 to 2000 lbs detonated in spherical cavities of 12- and 30-ft diameters. Wall pressures as a function of time are given together with some discussion of the explosive properties influencing the wall pressures. Some comparisons with measured pressures are included and an appendix contains further details of the explosion history of one typical problem (20 lbs in 12 ft cavity). The calculated wall-pressure histories are being used as inputs in an elastic propagation calculation. (auth)

23165 (RM-2696-AEC) POWER RECOVERY FROM THE KILAUEA IKI LAVA POOL. George C. Kennedy and David T. Griggs (RAND Corp., Santa Monica, Calif.). Dec. 12, 1960. Contract AT(11-1)-135. 25p.

The Kilauea Iki lava pool is being used to examine, as part of the Plowshare Program, the problems of recovery of power in useful form from molten rock. The pool is estimated to contain 80 million tons of molten lava with a total heat content of 3×10^{16} cal. It was calculated that if only the latent heat of fusion were recovered and converted to electricity at a thermal efficiency of 25%, this would yield 2×10^{9} kwh. At 5 mils per kwh, this would have a value of $10,000,000. Three general methods of power recovery are considered. The first is drilling a lattice of cased holes which would be used as counter-current-flow heat exchangers to heat fluids pumped in through a central co-axial pipe and collected from the exterior regions of the same pipe. The second is bubbling water from the lower end of a pipe inserted to the bottom of the lava pool and tapping steam which would collect nearby under the crust. The third is the formation of a thin horizontal bubble over the whole top of the pool under the crust, with central injection of the water and peripheral collection of the steam. It is shown that the exploitation of the Kilauea Iki lava pool could triple Hawaii's present rate of power production for ten years. (M.C.G.)

23166 (TID-4000(6th Rev.)) PUBLIC AVAILABILITY OF REPORTS ABSTRACTED IN NUCLEAR SCIENCE ABSTRACTS.

An alpha-numeric listing of all reports abstracted in Nuclear Science Abstracts (NSA) Vols 1 through 14, and its predecessor, Abstracts of Declassified Documents (ADD) is presented. The report number, the corresponding NSA volume and abstract number (or ADD volume and page number), and the latest known information concerning public availability are given. In many instances secondary report numbers are listed with cross references to the primary numbers. Prices and types of copy available are also included. (M.C.G.)

23167 (TID-12101) NUCLEAR MATERIALS CONTROL IN REACTOR FUEL FABRICATION. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1961. Contract AT(45-1)-1350. 85p.

The basic principles and techniques found necessary for the establishment and maintenance of an adequate control system for nuclear materials used in reactor fuel fabrication are discussed in terms of: process technology; measurement technology; records and reports; and analysis and control. As an aid in the application of the general principles for the control of the fuel fabrication materials, typical examples of practices used of recommended for similar operations in the United States are presented. (B.O.G.)

23168 (WT-1741) SURFACE MOTIONS FROM UNDERGROUND EXPLOSIONS. Final Report. D. S. Carder, L. M. Murphy, T. H. Pearce, and W. V. Mickey. Appendix A: RESPONSE SPECTRUM ANALYSIS OF RECORDS FROM EVENTS BLANCA AND LOGAN. William K. Cloud (Coast and Geodetic Survey, Washington, D. C.). Mar. 1961. Project 26.4 of Operation HARDTACK, Phase II. Contract AT(29-2)-746. 81p.

Ground effects resulting from certain HARDTACK II underground explosions were measured by strong-motion and teleseismic seismographs from 2000 feet to distances of nearly 100 miles. In addition, many temporary seismographs were operated by a number of organizations to distances of nearly 2400 miles, and routine seismographs continued to operate on a world wide basis. Some of the results are given. For safety purposes, predictions of ground effects, using formulas derived by the Coast and Geodetic Survey from pre-Rainier H.E. tests and modified slightly as a result of the Rainier tests, hold with reasonable accuracy. However, slightly revised formulas are believed to be more applicable to all ground displacements in the distance ranges covered in this report. An energetic wave believed reflected from the surface near the source was recorded by some of the strong-motion seismographs. It is out of phase with the initial wave and follows it by about a quarter second. From the ground effects standpoint, the Blanca shot was equivalent to a magnitude 4.8 earthquake, and seismic energy contained in a wave 0.8 km from the source is believed to contain about 0.4% of the yield energy. The Logan and Rainier shots were respectively equivalent to magnitude 4.5 and 4.1 earthquakes and corresponding seismic energies contained respectively 0.5 and 0.3% of the yield energy. (auth)

23169 (NP-tr-658) ATOMIC HORSES. A. Kulesca (Kulesza). Translated from Horyzonty Tech., No. 2, 63-8 (1960). 16p.

The advantages and problems of using atomic energy for aircraft and rocket propulsion are described. The possible engine types which may be used with a nuclear reactor are outlined, and the research programs being conducted in this field by U.S.A. and U.S.S.R. are described. (D.L.C.)

23170 LICENSING COSTS FOR NUCLEAR INSTALLATIONS. W. Borst. Atomwirtschaft, 6: 310-12(June 1961). (In German)

Licensing expenses for the erection, operation, or alteration of a nuclear installation are important factors in cost calculations. They will be regulated in the Federal Republic by the "Costing Ordinance to the Atom Law" which is now in preparation, excepting the costs arising through the first radiation protection ordinance and the so-called inspection procedure which, as a matter of principle, should be kept to fixed charges covering expenses. A reduction or abolition of charges is foreseen in order to promote development of atomic energy. (auth)

23171 1960-61 ANNUAL REPORT. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 1961. 32p. (AECL-1285).

The following topics are discussed: nuclear power program, research and development, Whiteshell nuclear research establishment, industrial participation, international co-operation, commercial products division, and the administration and finance. (N.W.R.)

23172 A SURVEY OF ION SOURCES FOR ELECTRICAL PROPULSION. K. M. Foreman (Republic Aviation Corp., Farmingdale, N. Y.). Preprint No. 60-7. Presented at the 6th National Annual Meeting, American Astronautical Society, January 18-21, 1960. New York, American Astronautical Society, 1960. 23p.

The effect of ion mass on thrust is shown for various design considerations such as fixed geometry and exit velocity, fixed chamber geometry and accelerating potential, constant ion current and accelerating potential, and constant ion current and accelerating voltage. Space charge effects are also considered. An historical review of 5 types of ion production is presented along with salient features of each method. Suggestions are offered for further research into ion sources, and problem areas resulting from application to propulsion systems are reviewed. (auth)

23173 SURVEY OF ION PROPULSION. Robert E. Supp (Wright Air Development Div., Wright-Patterson AFB, Ohio). [Paper No.] 1747-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 14p.

Electrostatic devices are generally categorized by the means used for ion production. These methods comprise contact ionization and bombardment (arc) ionization. The general problems include efficiency, reliability, and beam neutralization. The last of these problems necessitates in-space testing with either ballistic or orbital trajectories. Current ion propulsion programs are indicated. (auth)

23174 SURVEY OF ELECTROMAGNETIC PROPULSION. H. Harrison (National Aeronautics and Space Administration, Washington, D. C.). [Paper No.] 1749-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 7p.

A review of experimental MHD techniques is presented. The prospects for future uses of MHD devices as propulsion systems are outlined. Plasma ionization, stability, and acceleration techniques are described. Various devices are discussed. (T.F.H.)

23175 ELECTRIC PROPULSION DEVELOPMENT PROGRAM. Ernst Stuhlinger (George C. Marshall Space Flight Center, Huntsville, Ala.). [Paper No.] 1750-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 8p.

Research and development programs and relative merits of electric propulsion systems are discussed. The systems are classified as electro-thermal (arc jet), electro-static (ion), and electro-dynamic (magneto-fluid-mechanic). Flight testing in space, testing in satellites, and testing in conjunction with the SNAP-8 system are described. (T.F.H.)

23176 APPLICATIONS FOR ELECTRIC PROPULSION SYSTEMS. J. W. Stearns (Jet Propulsion Lab., California Inst. of Tech., Pasadena). [Paper No.] 1751-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 16p.

Unmanned missions for exploration of the solar system are described. Special attention is devoted to missions such as solar probes to the edge of Jupiter, within the solar corona (0.094 AU), or out of the plane of the ecliptic to high celestial latitudes. For most of the unmanned missions

examined, spacecraft with electric propulsion offer a significant performance advantage over comparable chemical spacecraft; for many, the electric vehicles appear to offer the only means of performing the missions. A great deal of latitude exists in the selection of power and weight of the nuclear-electric power plants. In order to clarify expected requirements, summary curves are presented showing a range of powerplant weights and powers for various mission flights. (auth)

23177 SURVEY OF HIGH ENERGY SPUTTERING EXPERIMENTS. D. E. Harrison, Jr. (Univ. of Toledo) and O. C. Yonts. [Paper No.] 1752-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 18p.

Cathode sputtering of metals at energies above 1 kev is surveyed. Various parameters that affect the sputtering yield are studied, including incident ion energy, angle, and nature. Examples are shown of Ag and Cu sputtering by Ar^+; Al, Ag, and Cu sputtering by He^+; Ag and Cu sputtering by D^+; Mo sputtering by Hg^+; and Cu sputtering by N^+. Spot patterns obtained by transmission sputtering are discussed. (T.F.H.)

23178 THE NUCLEAR ENERGY INDUSTRY OF THE UNITED KINGDOM. (United Kingdom Atomic Energy Authority, London). Jan. 1961. 71p.

The goods and services that can be provided by British industry and by the Atomic Energy Authority in the field of nuclear energy are described. Topics covered include: the gas-cooled, graphite-moderated, power-producing reactor; the manufacture and export of power reactors, chemical process plants, and auxiliary equipment; the export of natural uranium fuel elements for gas-cooled reactors; reactor safety and siting; insurance of overseas reactors and risks arising from radioisotopes; research and materials testing reactors supplied by British firms; other British industrial organizations in the reactor field; radioisotopes and stable isotopes; British nucleonic instruments and equipment; training facilities in nuclear science; and information on the applications of atomic energy. (M.C.G.)

BIOLOGY AND MEDICINE

General and Miscellaneous

23179 (AD-250822) MEASUREMENT OF RADIOACTIVE ISOMERS PRODUCED BY GAMMA RAYS. Report No. 1 (Progress), November 27, 1959–March 31, 1960. Richard A. Glass, Herbert D. Smith, and R. S. Farrand (Stanford Research Inst., Menlo Park, Calif.). Contract DA19-129-qm-1511. 7p.

Work is under way to establish the level of induced radioactivity in typical radiation-sterilized foods. Fourteen isotopes of eleven elements were irradiated: Fe, Nb, Cd, In, Sn, Te, Ba, Lu, Os, Hg, and Pb. Typical gamma spectra observed are shown. (M.C.G.)

23180 (AD-250823) MEASUREMENT OF RADIOACTIVE ISOMERS PRODUCED BY GAMMA RAYS. Report No. 2 (Progress), April 1–May 30, 1960. Richard A. Glass and Herbert D. Smith (Stanford Research Inst., Menlo Park, Calif.). May 31, 1960. Contract DA19-129-QM-1511. 4p.

Irradiations of elements and foods by x rays and gamma rays are being carried out to determine radioactive isomer production in food. Elements being irradiated include Sr, Nb, Rh, In, Te, Ba, Lu, Hf, Os, Pt, Hg, Fe, Zn, Ag, Cd, Sn, and Pb. Foods being irradiated are beef, bacon, shrimp, chicken, and green beans. (M.C.G.)

23181 (AD-250828) MEASUREMENT OF RADIOACTIVE ISOMERS PRODUCED BY GAMMA RAYS. Report No. 3 (Final), November 26, 1959–August 31, 1960. Richard A. Glass and Herbert D. Smith (Stanford Research Inst., Menlo Park, Calif.). Oct. 3, 1960. Contract DA19-129-QM-1511. 71p.

A three-phase experimental program was pursued in which irradiations were performed on a group of elements expected to produce isomers, a group of food elements, and a group of foods including beef, bacon, shrimp, chicken, and green beans. A variety of radiation sources were used including Cs^{137}, Co^{60}, and spent reactor fuel element gamma sources in addition to 4, 8, 16, and 24 Mev x-ray sources. Samples were irradiated to convenient radiation doses following which gamma counting was performed with a NaI well crystal, or beta counting was performed with a low-background Geiger counter. Among the 1- to 20-gram element samples, radioactivities of 1 to 10^4 counts/minute were observed, attributable to the following isomers: Sr^{87m}, Cd^{111m}, In^{113m}, In^{115m}, Sn^{117m}, Te^{123m}, Te^{125m}, Ba^{135m}, Lu^{176m}, Hf^{180m}, Os^{190m}, Pt^{195m}, Hg^{199m}, and Pb^{204m}. Isomer yields increased greatly from the lowest-energy source to the highest. No definite induced isomer radioactivity was found in samples of whole food or food ash. The observed isomer radioactivities were used to develop an empirical relationship to calculate radioactivity values for undetected isomers. The formula was used to calculate yields for all known isomers of stable elements with half-life longer than one-half minute. Results indicated that sterilization with gamma and x-ray sources does not add a significant amount to natural radiation levels in foods. (auth)

23182 (AD-251501) STABILIZING IRRADIATED MEATS AGAINST OXIDATIVE CHANGES DURING STORAGE. Report No. 7 (Progress), May 1, 1960–July 31, 1960. Betty M. Watts (Florida State Univ., Tallahassee). Contract DA19-129-qm-1321. 7p.

Slices of roast beef, roast pork, and meat loaf with and without antioxidant treatments, were packaged in flexible films, radiated (3.5×10^5 rad) and stored under refrigeration. This dose increased storage life 1.5 to 5 times. Radiation odor was not detectable. Antioxidant dips eliminated rancidity but under some conditions produced a foreign odor. (auth)

23183 (AD-251651) FUNDAMENTAL STUDIES OF RADIATION SOURCE DOSIMETRY AND THE EFFECTS OF IONIZING RADIATION ON SUGARS. Report No. 8 (Annual), April 1, 1959–March 31, 1960. J. S. Andrews (General Mills, Inc. Central Research Labs., Minneapolis). Contract QMR&E (Natick) No. 78. 4p.

Progress in dose distribution studies employing a cellophane-dye dosimeter is described. Pressures produced by the gamma-irradiation of sucrose and glucose solutions were measured. At 5 megarads the pressure was approximately 11 psi for sucrose and 14.5 psi for glucose, at 30% concentration. The pressure curves for 20% and 40% sucrose solutions were very slightly different from the curve for 30%. Small postirradiation pressure increases were also observed. (auth)

23184 (AD-252822) RESEARCH STUDY ON CAN ENAMELS AS PART OF THE RADIATION PRESERVATION OF FOODS PROGRAM. Report No. 11 (Final), May 29, 1957–May 29, 1960. G. B. Pratt (American Can Co., Barrington, Ill.). Contract DA19-129-QM-968. 105p.

Experiments were carried out to determine the types of interior can enamels suitable for foods to be processed with ionizing radiation. These experiments were also designed to determine if the effects of radiation and subsequent storage on the can enamel differ from the effects of heat processing and subsequent storage with respect to performance and safety to public health. One or more satisfactory can enamels were found for each of representative irradiated products in the experiment. No evidence was discovered to indicate that any hazard to the public health will be introduced by irradiated can enamels. (auth)

23185 (AD-252830) STABILIZING IRRADIATED MEATS AGAINST OXIDATIVE CHANGES DURING STORAGE. Report No. 8 (Final), October 1, 1958–September 30, 1960. Betty M. Watts (Florida State Univ., Tallahassee). Contract DA19-129-QM-1321. 68p.

An investigation was made of the oxidation of the cellular lipids in lean cooked meats as a contributing factor in the flavor deterioration of irradiated cooked meats. Since the lipid fractions responsible for the off odors developing in stored cooked meats are not easily extractable by fat solvents, their oxidation was followed by the thiobarbituric acid reaction which could be performed either directly on the meat tissues or on distillates from whole tissues. An improved distillation procedure was developed and compared with other methods in current use. The method was used to follow the oxidation of pure, unsaturated fatty acids under controlled conditions. Lipid oxidation as measured by the TBA number occurred in the lean meat of all meat animals after moderate cooking (temperatures of 60 to 90°C). There was less subsequent oxidation after prolonged cooking at high temperatures. Exposed slices of primal cuts, cooked whole, developed higher TBA numbers than ground meat. In general, lipid oxidation as measured by TBA numbers correlated well with rancid odor ratings. The ferric heme pigments of cooked meats are believed to catalyze the oxidation, whereas the ferrous hemes of cured

meat and the pink hemochromogens which develop in irradiated cooked meats are much less active as catalysts. A theory is presented to explain differences in the catalytic activity of various heme pigments. Lipid oxidation was found to cause a substantial part of the off odor of irradiation sterilized ground pork. This type of rancidity could be eliminated by the incorporation of suitable antioxidants, especially polyphosphates, into the meat before cooking, with resulting improvement in odor of the irradiated stored pork. Slices of roast beef preserved by refrigeration or freezing developed very high TBA numbers and strong rancid odors. This lipid oxidation could be eliminated by dipping the slices in antioxidant solutions immediately after cooking, with pronounced flavor improvement. However, lipid oxidation was not a substantial component of irradiation sterilized roast beef and no improvement in flavor was obtained by antioxidant treatment of the irradiated material. A few experiments on low level radiation (pasteurization) of roast beef, pork and meat loaf gave promising results in samples treated with antioxidants. (auth)

23186 (BNL-5417) OBSERVATIONS ON NUCLEAR RNA LABELED WITH TRITIATED CYTIDINE IN HUMAN CANCER CELLS IN CULTURE (HeLa). L. E. Feinendegen and V. P. Bond (Brookhaven National Lab., Upton, N.Y.). 1961. 13p.

Presented at the International Symposium on Nuclear Energy and Isotopes in Biology and Medicine, Cologne, Germany.

The total H^3 activity of the RNA fraction of HeLa tissue culture cells was measured at varying times after 90 and 120 min exposure of the cultures to H^3-cytidine. The results indicate that (1) the majority of macromolecular RNA is preserved, (2) some of the initially labeled RNA converted temporarily to a soluble fraction from which it was recovered as macromolecular RNA within 4 to 6 hr, and (3) the majority of newly synthesized macromolecular RNA in the nucleus dissociated from the chromatin during mitosis and contributed to cytoplasmic RNA. (D.L.C.)

23187 (BNL-5512) STUDIES OF AIRBORNE POLLEN AT BROOKHAVEN NATIONAL LABORATORY. Gilbert S. Raynor, Maynard E. Smith, and Irving A. Singer (Brookhaven National Lab., Upton, N. Y.), and Eugene C. Ogden (New York. State Museum and Science Service, Albany). [1960]. 29p.

The development of pollen samplers and of methods of tagging ragweed pollen is described, and preliminary data collected from 72 sampling stations located at four distances from a field of cultivated ragweed are reported. (D.L.C.)

23188 (LAMS-2526) BIOLOGICAL AND MEDICAL RESEARCH GROUP (H-4) OF THE HEALTH DIVISION–SEMIANNUAL REPORT, JULY–DECEMBER 1960. (Los Alamos Scientific Lab., N. Mex.). Jan. 1961. Contract W-7405-ENG-36. 412p.

Separate abstracts have been prepared on the 47 sections of this report. Papers published during the period covered by the report are listed. (C.H.)

23189 (LAMS-2526(p.275-8)) PROTECTION OF CFW SWISS MICE FROM POST IRRADIATION TRANSPLANTABLE AK LEUKEMIA BY PREIRRADIATION IMMUNIZATION. I. U. Boone, L. M. Conklin, and L. T. Rivera (Los Alamos Scientific Lab., N. Mex.).

Preliminary results are reported from studies on immune reactions involved in the protection of CFW Swiss mice from post-irradiation transplantable AK leukemia by preirradiation immunization with AK leukemic spleen homogenates. Data are tabulated from a series of experiments designed to determine if the protection was due to a specific or nonspecific immunity. (C.H.)

23190 (LAMS-2526(p.306-13)) INFLUENCE OF EXTRATERRESTRIAL GRAVITATIONAL FIELDS UPON PLANT GROWTH. E. R. Ballinger and E. F. Montoya (Los Alamos Scientific Lab., N. Mex.).

Problems involved in the growth of edible plants to support man's existence under such gravitational fields as would be encountered in space and on planets other than earth are considered. Results are reviewed from previous studies of plants grown on a wheel which indicate that plants exhibit directional dependence in a gravitational field and are unable to distinguish between the effects of gravitational and centrifugal forces affecting orientation of growth of stems and roots. The literature on organ-forming substances in plants is reviewed briefly. Results are reported from preliminary studies on the relation of gravity to stem development. Plants were grown in rings around a 3-ft diameter centrifuge designed to allow observations on growth of plant stems at 2, 4, and 6 G. Most of the plants grew toward the center of the wheel in a tangential manner. The apparatus is illustrated photographically. (C.H.)

23191 (LAMS-2526(p.401-14)) VETERINARY SERVICES SECTION. (Los Alamos Scientific Lab., N. Mex.).

Mechanized mouse cage washing equipment is described. Procedures are discussed for handling dogs and monkeys for whole-body counting during metabolic studies employing radioisotopes. (C.H.)

23192 (NP-9579) TO DETERMINE THE EFFECT OF IRRADIATION UPON THE WHOLESOMENESS OF FOOD. Progress Report No. 10 for Period March 1960–September 1960. Elwood F. Reber, O. P. Malhotra, P. D. Beamer, H. W. Norton, and J. Simon (Illinois. Univ., Coll. of Veterinary Medicine and Illinois. Agricultural Experimental Station, Urbana). 61p. Contract DA-49-007-MD-72800.

A report on the wholesomeness of one of the two foods investigated as part of a contract to determine the effect of irradiation upon the wholesomeness of beef is presented. Feeding beef irradiated with 2.79 megarads in a ration which was hemorrhagenic for male rats did not cause death nor prolong prothrombin times in male beagle hounds or in male cats during a 40-week experimental period. The amount of vitamin K required by castrated rats to prevent prolonged prothrombin time and to prevent death due to hemorrhage increased with increased levels of testosterone. The adult male rat is more susceptible to the factors which cause the hemorrhagic disease than is the weanling male rat. The addition of 2% DL methionine to a hemorrhagenic ration completely prevented prolonged prothrombin time and protected against death due to hemorrhage in male weanling and adult rats. The data indicate that the effect of coprophagy is of less importance as a factor in the hemorrhagic syndrome than is the effect of the strain of rat, vitamin K, the level of methionine in the ration, and sex hormones. (auth)

23193 (NP-10316) HUMAN INTERNAL RADIOISOTOPE DOSIMETRY, INSTRUMENTATION, PROPHYLAXIS AND THERAPY. Annual Progress Report, July 1, 1960–June 30, 1961. George R. Meneely (Vanderbilt Univ., Nashville. School of Medicine). June 30, 1961. Contract DA-49-007-MD-995. 116p.

A portable spectrometer was designed for field whole-body isotope burden evaluation. A beta counter was constructed capable of measuring strontium-90 samples having activities as low as 25 $\mu\mu$c. A single-channel spectrometer

for whole-body clinical studies was developed as an expedient adjunct to the 256-channel analyzer. Combining data from an absolute "microcurie" calibration of the steel-room with that obtained from fifteen people, a habitus efficiency relation was deduced for a potassium and cesium factor; hence a known amount of these elements in individuals. High concentrations of cesium-137 in skeletal muscle and other soft tissue prevailed in treated and untreated rats. Concentrations in blood were low, urinary excretion insignificant, indicating that once associated with a tissue, cesium is bound in part as a complex. In establishing normal potassium and cesium-137 levels in man, 1453 spectrometer studies, 605 from a randomly selected sample of households of Nashville and environs were made. Twenty students fed supplemental potassium or placebo for 30 days failed to show changes in total body burden of cesium-137 or variation in total body, serum or red-cell potassium. (auth)

23194 (ORO-375) SEMIANNUAL PROGRESS REPORT FOR JULY 1, 1960–DECEMBER 31, 1960. (Tennessee. Univ., Oak Ridge. UT-AEC Agricultural Research Lab.). Contract AT(40-1)-GEN-242.

Progress is reported in studies on the metabolism of fission products and chemically related nuclides in domestic animals, the effects of radiation on reproductive physiology of farm animals, the effects of radiation on botanical materials, and the chemistry of fission products and related nuclides in soils and biological materials. Data are included on the effect of cooking on Cs^{134} levels in meat; in vitro studies on fat hydrogenation; the effects of diet on the tissue distribution of Mo^{99}, Cu^{64}, and Fe^{59} in swine; the absorption of thyroxine-I^{131} in swine, sheep, and cattle; effects of parathyroid extract on Ca, P, Mg, and citric acid metabolism in dairy cattle; the kinetics of distribution and incorporation in milk of Ca^{45} and P^{32} in dairy cows; the relationships of dietary Ca, P, and vitamin D on various responses in growing rats; the development of a rapid technique for the determination of Ca^{45}, P^{32}, and Sr^{89} in biological materials; tracer studies on the distribution and retention of Cs and Sr in protein fractions of eggs and the distribution of Ca, Sr, and Ba in the tissues of hens; the effects of whole-body and in utero irradiation on fertility in cattle; the status of burros and swine surviving neutron-gamma irradiation from an atomic detonation; preliminary results on central nervous system injury resulting from irradiation of the head of sheep, swine, and cattle; pathological effects of radiation as demonstrated in ovine, porcine, equine, and bovine tissues following 39 necropsies; the radiosensitivity of seeds under various combinations of soaking and storage; the dose response of a number of seeds to Co^{60} γ rays and fission neutrons; radioinduced mutations in various varieties of plants; and measurements of the diffusion of Sr in various soil systems. A list is included of publications during the period covered. (C.H.)

23195 (ORO-416) FORMATION OF TISSUE PHOSPHOLIPIDS AND TOXICITY OF P^{32} AS RELATED TO DIETARY FACTORS. Camillo Artom (Wake Forest Coll., Winston-Salem, N. C. Bowman Gray School of Medicine). May 31, 1961. Contract AT-(40-1)-1638. 20p.

Results are reported from a series of in vitro and in vivo tracer studies on the synthesis of phospholipids. Reaction mechanisms and enzyme systems involved are discussed. Data are included from studies on phospholipid synthesis in atherosclerosis–susceptible or non-susceptible pigeons. The role of alterations in the metabolism of lipids or lipid fractions in the pathogenesis of atherosclerotic lesions is discussed. Studies on the effects of dietary fats on radiation injuries from ingested P^{32} in mice showed that mortality was lowest in animals fed fat-free on low-fat diets, as long as a deficiency of essential fatty acid did not develop. Findings indicate that vitamins favor recovery from radiation injuries. A list is included of papers resulting from the investigations reported. (C.H.)

23196 (TID-12830) THE GENETIC FUNCTIONING OF HETEROCHROMATIN. Final Report. William K. Baker (Chicago. Univ.). [1961]. Contract AT(11-1)-431. 8p.

The general properties of chromosome regions that are described as being heterochromatic are discussed. Since these chromosome regions contain relatively few genes, as defined by the usual operational techniques, their genetic function is unveiled only in rather special situations such as position-effect variegation. Although these situations may be special, the heterochromatic portions of chromosomes are appreciable in size. In most species of Drosophila, from a fourth to a half of the proximal portion of each chromosome arm is heterochromatic in the usual somatic cell. The effect of heterochromatin on gene action can easily be detected by using chromosome rearrangement which relocated the wild-type allele of a gene that normally resides in auchromatin to a region of heterochromatin. Under these circumstances, the usual dominant behavior of the wild-type allele does not prevail with the result that in some somatic cells the recessive characteristics are shown, thus producing variegated tissue. In addition to this direct effect on gene action, the addition or subtraction of heterochromatin to the genome affects the action of the gene when it is involved in such a chromosome rearrangement. Therefore, the phenomenon of position-effect variegation offers a tool for determining qualitative and quantitative effects of heterochromatic regions on gene action. The effects of heterochromatin are not limited to gene action since it has been shown that these regions located in different chromosomes still share some homology and thus they are important in chromosome pairing, crossing over, and disjunction. In particular, heterochromatic regions may play an important role in the interchromosomal effects on crossing over and disjunction; i.e., the heterochromatic constitution on one pair of chromosomes may affect the amount of recombination in another non-homologous pair. A brief summary is presented of the results of studies on the functioning of heterochromatin. (C.H.)

23197 (TID-12884) FATE OF RADIOACTIVE CONTAMINANTS IN WATER. Progress Report No. 2 for the Period May 1, 1958 to June 30, 1959. (Robert A. Taft Sanitary Engineering Center, Cincinnati). 1960. Contract AT(49-5)-1288. 38p. (SEC-TR-R60-2; A/AC.82/G/L.571)

Changes made in existing equipment to improve sensitivity are described and spectra shown for specific radioisotopes. Improvements of analytical and counting methods for tritium and radioisotopes in sea water and algae are discussed. Results are presented for laboratory and field samples collected at KAPL, Savannah River, and Shippingport. (D.L.C.)

23198 (TID-12906) THE BIOLOGICAL EFFECTS OF STRESSFUL AGENTS AS RELATED TO DIET. Willard J. Visek (Chicago. Univ.). June 12, 1961. Contract AT(11-1)-670. 40p.

Urease is produced by plants, fungi, and 200 species of bacteria. Urease producing bacteria were found to be resistant to antibiotics. The enzyme was found to be produced by bacteria which are normally found in the gastrointestinal tract of man and animals. Urease pro-

duces ammonia through urea hydrolysis. The substrate, urea, is constantly produced by mammalian tissues and is carried by tissue fluid and other secretions to the area where the enzyme is active. Ammonia, a known toxin produced by this process, is detoxified in the liver by reconversion to urea. In the case of birds or certain mammals which produce uric acid, this substance was found to be decomposed to urea by bacteria and to serve indirectly as a substrate for urease. Inhibition of urea breakdown by this process produced growth increases of 10 to 40% in experiments with rats and chickens. Inhibition of urease activity followed the addition of antibacterial agents to the diet, and good results were obtained with penicillin, chlortetracycline, and arsanilic acid. These inhibited the formation of urease by bacteria of the intestinal tract in both in vitro and in vivo studies and also appeared to alter bacterial growth under certain circumstances. Immunity to jackbean urease resulted in the passage of antiurease into the gastrointestinal and urinary tracts, thereby inhibiting the formation of bacterial enzymes in rats and chickens. A highly sensitive and reliable hemagglutination technique was developed for the detection of antiurease. Antiurease was not found in the sera of normal birds, laboratory animals, or man. Preliminary screening of sera from hospital patients indicates that the antibody may be significant in patients with certain diseases. A list is included of papers published and abstracts are included of papers presented at scientific meetings during the period covered. (C.H.)

23199 (TID-13029) FINAL REPORT [ON BIOLOGICAL RESEARCH]. ([Wisconsin. Univ., Madison]). [1961]. Contract AT(11-1)-64. 6p.

Results are reported from studies on CO_2 fixation by Aspergillus niger extracts, N fixation by Bacillus polymxa and Achromobacter N4, calcium requirements in Azotobacter vinelandii, and the properties of spheroplasts from Aerobacter aerogenes. (C.H.)

23200 (TID-13108) THE USE OF RADIOPHOSPHORUS IN DETERMINING FOOD CHAIN RELATIONSHIPS IN THE AQUATIC ENVIRONMENT. Final Report. Dale A. Hoffman (Colorado State Univ., Fort Collins) and John R. Olive (American Inst. of Biological Sciences, Washington, D. C.). [1961]. Contract AT(11-1)-398. 46p.

Experiments were conducted to determine the accumulation and concentration of P^{32} by a simple food chain consisting of green algae, microcrustaceans Daphnia, and Green Sunfish in river water. The accumulations and concentration factors of the organisms were found to be greater at 25 than at 10°C. The results indicate that the algae increased the amount of P for Daphnia in the first 24 hr and decreased P after longer periods, and that the amount of P^{32} accumulated by Daphnia is proportional to the amount of surface area available for P adsorption. Data were obtained on the aquisition of P^{32} by the sunfish from various food-chain combinations. (D.L.C.)

23201 (TID-13109) EXPERIMENTS ON THE UPTAKE OF RADIOACTIVE PHOSPHOROUS FROM THE WATER AND FROM A SINGLE ORAL DOSE BY BROOK AND RAINBOW TROUT. Wesley C. Nelson (Colorado. Dept. of Game and Fish, Denver). Jan. 3, 1961. 22p.

Experiments were carried out to determine whether P^{32} uptake by trout was via food or water and to define the patterns of P^{32} uptake by different trout tissues. In the experiment with P^{32}-tagged water under simulated field conditions, no P^{32} was detected in the water after 4 hr nor in the fish sampled after periods up to 72 hr. With relatively concentrated P^{32} in water in aquaria, small amounts of P^{32} were found in the gills and intestine. Experiments on P^{32} uptake from single oral doses showed that P^{32} was rapidly and efficiently absorbed by trout and that the stomach was the major site of absorption. The rates of uptake by the other tissues were measured. It is concluded that P^{32} uptake directly from the water by the trout is negligible compared with uptake via food. (D.L.C.)

23202 (TID-13124) BRAIN FUNCTION, BEHAVIOR, AND IRRADIATION. Technical Progress Report. J. Olds (Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts). June 1961. Contract AT(11-1)-953. 3p. (ORA-04289-1-P)

Gamma radiation dose rates of 10 to 1000 r/hr were applied by implanted gold wires to hypothalamic points involved in self-stimulation behavior. No changes were noted due to the irradiation up to 6000 r. With doses > 10,000 r, temporary after-effects appeared: several days after the high dose, animals ceased to respond to the brain stimulus, and response was recovered after several weeks. (D.L.C.)

23203 (TID-13167) EVALUATION OF EFFECTS OF RADIATIONS ON QUANTITATIVE CHARACTERS IN CORN AND SOYBEANS. Final Report for Period May 1, 1955 to April 30, 1960. C. O. Gardner, D. G. Hanway, and J. H. Williams (Nebraska. Univ., Lincoln). [1961?]. 93p. Contract AT(11-1)-352.

The effects of radiation on the genetic variability in quantitative characters of populations of corn and soybeans were evaluated. The results for corn pollen and seed irradiation with ultraviolet and thermal neutrons indicate that the additive fraction of the genetic variance is most affected and that irradiation increased deleterious recessive genes and decreased the yield. X-ray and thermal neutron irradiation of soybean seeds increased the genetic variability, heritability, and genetic gains; gains made by selection for yield in irradiated populations were greater than in the control, although the mean yield was reduced. (D.L.C.)

23204 (UCLA-478) RECENT USES OF A TOTAL BODY COUNTER FACILITY IN METABOLIC RESEARCH AND CLINICAL DIAGNOSIS WITH RADIONUCLIDES. Norman S. MacDonald (California. Univ., Los Angeles. School of Medicine). June 16, 1961. Contract AT-04-1-GEN-12. 31p.

Combination of a thick-walled moderately sized, steel chamber of the Argonne type with an array of four matched NaI scintillation detectors for multichannel pulse height analysis constitutes an exceptionally versatile facility for study of gamma emitting radionuclides in the human body. The excellent sensitivity and energy resolution of the system is demonstrated in the detection of an unexpected mμc burden of Sb^{124} (0.61 Mev) in the presence of the normal burden of Cs^{137} (0.67 Mev) in the body of a laboratory worker. Use of a Hg collimating shield yielded data on the pulmonary retention and physiological turnover of Mn^{54} in a case of accidental inhalation of dust containing fission products and neutron activation products. However, the greatest potentialities of total-body counter assemblies lie in their application to clinical research. By measuring total-body retention of radiocobalt labeled vitamin B_{12}, diagnosis of pernicious anemia has been accomplished conveniently with doses of only 0.02 microcuries. By use of Co^{58} label and the Total Body Counter Facility the dose of radiation to the patient is greatly reduced. Results are not altered by other radionuclides in the patient resulting from prior tests. Aberrations in metabolism of thyroxine are currently under study by measurement of the daily loss of I^{131} following intravenous injection of 0.03 microcuries of I^{131} labeled thyroxine and oral administration of KI. Study

of the behavior of Sr^{85} immediately after injection into patients with osteoporosis and other skeletal disorders has aided diagnosis of such disease. By conducting the radioisotope osteogram test inside the low background chamber and using large crystal detectors, the administration dose can be reduced to sub microcurie levels. Body retention is measurable over a period of months. Another diagnostic application is the evaluation of abnormal loss of serum protein into the intestine. I^{131} labeled serum albumin is injected intravenously and the daily loss is determined by total body counting. Thyroid uptake of I^{131} split off from circulating tagged albumin is blocked by oral administration of KI. (auth)

23205 (UCRL-9519) BIO-ORGANIC CHEMISTRY QUARTERLY REPORT, SEPTEMBER THROUGH NOVEMBER 1960. (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 31, 1961. Contract W-7405-eng-48. 65p.

The catalytic activities of Fe, Co, Mg, Ca, Zn, Mn, Cu, and K with enzyme systems are reviewed briefly. Current studies pertinent to enzyme action are those covering the physics of colloid systems, studies of ion binding of polyelectrolytes and their properties, and studies of super-rate kinetics of intramolecularly reacting chemical groups, usually located vicinally to one another in a molecule or separated by four carbon-bond lengths. Preliminary profiles are presented of experimental conditions affecting the interaction of heavy-metal ions with salts of polyvinylsulfonic acid, a polymer which is known to yield aqueous complex-coacervate solutions. Experiments on the condensation of isoprene in the presence of phosphoric acid with phenols showed that the condensation results in a product with the atoms arranged as required, that dialkylation is preferred under the reaction conditions whereby the starting hydroquinone is practically insoluble in toluene, and that the quantity of acid and the time and temperature favor formation of chroman over the hydroquinone. The ultraviolet absorption spectra of some phenyl esters were measured to investigate the relationship between bonding and absorption. Data are tabulated. The deamination of adenine, adenosine, and adenylic acid to hypoxanine was observed after exposure of aqueous solutions to γ radiation. The influence of 5-Mev electrons on mixtures of CH_4, C_2H_4, C_2H_6, NH_3, H_2, and H_2O was investigated by employing $C^{14}H_4$. Procedures and results are discussed. Crystal violet was identified as a product of a solution of o-chloranil in dimethyl aniline. Electron spin resonance techniques failed to establish a positive connection between observed free radicals and extracted pigments or the Hill reactivity as such in spinach chloroplasts. The role of proteins and enzymes in the fixation of C^{14} in aqueous and nonaqueous chloroplasts was investigated. Data are tabulated. Procedures are described for the determination of carboxylic acids on paper chromatograms. A cutaway drawing depicts a new scintillation detector unit for room-temperature operation. Typical counting data are tabulated. Results from preliminary studies indicate that D_2O in the drinking water of male mice causes a decrease in litter sizes. (C.H.)

23206 (UCRL-9617) BIOLOGY AND MEDICINE SEMIANNUAL REPORT, SPRING 1961. John H. Lawrence, ed. (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 1961. Contract W-7405-eng-48. 105p.

The experimental setup and dosimetry are described for exposing biologic samples in the wet state and under controlled gaseous atmospheres to the effects of heavy ions from a linear accelerator. The use of fluorescein staining as a sensitive and semiquantitative indicator of injury to brain tissue following localized irradiation by α particles from the 184-in. cyclotron is described. The method was used to demonstrate the greater radiosensitivity of the primate brain. Data are included from studies on monkeys, rats, and rabbits. Results are included from preliminary studies on the effect of a complexing agent and mode of administration on the distribution of Cm^{242} in rats. Tracer studies in female cancer patients who had received pituitary irradiation gave evidence in support of a direct conversion of testosterone to estrogens. The apparatus and procedures are described. High-resolution radioautography, following the administration of tritiated thymidine to mice, was used to study plasmocytopoiesis in the regional lymph nodes of mice after multiple injections of antigen. Procedures and results are described. Studies of mating behavior in Drosophila are reported in which the mating preferences of D. melanogaster were determined when individual males were allowed to choose between two females of the same genotype or two females of different genotypes. Results are reported from a series of studies on the effects of radiation on proteins. The results support the concept that major chemical effects of both the direct and indirect action of ionizing radiation on protein involve reactions at C-N bond loci, that these reactions under appropriate conditions can lead to C-N bond cleavage, and that the fundamental characteristics of the cleavage reactions are essentially independent of the nature of the group or linkage with which the C-N bond is associated. Studies on the chemical nature of erythropoietic hormone activity are described. Whole-body radioactivity counts are reported for normal individuals, patients with tracer doses of Fe^{59}, and a variety of cases of exposure to internal radionuclides. A list is included of staff publications during the period covered. (C.H.)

23207 (AEC-tr-4645) LIGHT REACTIONS OF PHYCOMYCES. Werner Reichardt. Translated by Lydia Venters (Argonne National Lab.) from Kybernetik, 1: No. 1, 6(1961). 37p.

Phycomyces is a multinuclear, single cell fungus. Its sporophores are postively phototropic and respond to changes in light with reactions in growth. Both reactions are of a standard type and physiologically closely related. Results are reported from a series of studies on the response of Phycomyces to light. (C.H.)

23208 (AEC-tr-4736) THE EFFECT OF REPEATED LOSSES OF BLOOD ON THE DEVELOPMENT OF YOUNG RATS. E. Travnickova. Translated from Ceskoslov. Fysiol., 9: 59-60(1960). 4p.

The effects of repeated blood loss on the erythrocytes, hemoglobin, skin reflexes, and body weight were studied in young rats. After blood losses amounting to 2.7 to 1.2% of the body weight were induced over a 12-day period, decreases were observed in the weight, erythrocytes, and hemoglobin, although the erythrocytes increased relatively quickly after the second day. The skin reflex effects agree with those in decorticated and starved rats. (D.L.C.)

23209 RADIATION EXPOSURE IN BODY-SECTION RADIOGRAPHY. F. E. Stieve (Universität, Munich). Acta Radiol., 55: 465-85(June 1961). (In English)

The radiation dose at section radiography was determined by means of measurements on phantoms, cadavers, and living subjects. Both in the area of direct radiation and in surrounding areas the dose, with slightly varying distribution, is of the same order as in survey radiography under identical conditions. Dose requirements in both sectional and standard radiography are governed by the

same rules. The statistical assessment of the results of measurements of gonad doses in patients indicates that in a properly executed examination the radiation received during tomography makes only an insignificant contribution to the total radiation exposure of the population during diagnostic roentgen examinations. (auth)

23210 EFFECT OF REMOVAL OF LYMPHATIC TISSUE ON IMMUNE RESPONSE IN MICE. D. C. Swartzendruber, R. R. Bigelow, C. C. Congdon, and T. Makinodan (Oak Ridge National Lab., Tenn.). Am. J. Physiol., 200: 1272-6(June 1961).

Extensive lymphatic tissue removal in mice prolonged skin homograft survival as long as 32 days in one animal, but the longest median rejection time for a given experiment was 17 days. The longest homograft survival in sham-operated controls was 14 days; median rejection time was 10 days. A median rejection time of 18 days was seen in a few mice given 400 r after the extensive lymphatic tissue removal. When second set homograft response was studied there was no significant effect of the tissue removal. Extensive lymphatic tissue removal markedly reduced the serum antibody response to a small dose of sheep RBC antigen for both the primary and secondary responses. Relatively little recovery of ability to respond was seen with the primary response during the 18-day period of observation. Lymphatic tissue removal did not alter the serum protein electrophoretic mobility pattern. Little compensatory hyperplasia of residual or ectopic lymphatic tissue was seen at the completion of the experiments. Regeneration of lymphatic tissue did not take place at operative sites except near the pancreas where complete extirpation of lymph nodes was difficult to perform. (auth)

23211 LOW TEMPERATURE PREPARATION TECHNIQUES FOR ELECTRON MICROSCOPY OF BIOLOGICAL SPECIMENS BASED ON RAPID FREEZING WITH LIQUID HELIUM II. Humberto Fernández-Morán (Massachusetts General Hospital, Boston and Massachusetts Inst. of Tech., Cambridge). Ann. N. Y. Acad. Sci., 85: 689-713(Apr. 13, 1960).

Low temperature preparation techniques were developed that give better morphologic and cytochemical preservation of biological specimens. Although intended primarily for electron microscopy, the approaches embodied in these techniques are potentially suitable for long-term preservation of biological systems. The new cryofixation techniques are based essentially on combined application of: rapid freezing of fresh or glycerinated tissues with liquid He at 1 to 2°K; subsequent staining at −150°C with halogens or organometallic compounds dissolved in isopentane; substitution of the ice matrix in alcohols, acetone mixtures with alkyl halides, or certain organometallic compounds at −130 to −80°C; and infiltration with suitable acrylic monomers and final embedding by photopolymerization with uv light at −80 to −30°C, thus permeating the macromolecular matrix of the specimen and permanently stabilizing its fine structure over a wide range of temperatures. Preliminary applications of high-resolution autoradiography techniques for electron microscopy at low temperatures are discussed. Preliminary results are described from a direct study of ice-crystal structure and growth by low temperature electron microscopy, using a liquid nitrogen stage for cooling during observation with a low-intensity microbeam. (P.C.H.)

23212 X-RAY DETECTION OF HETEROGENEOUS SUBSTANCES IN FOOD PACKAGES. A. Berger. Deut. Lebensm.-Rundschau, No. 56, 247-52(1960).

Cans as well as other packages of food and also loose food were x-rayed to detect unwanted heterogeneous substances. A formula gives the required values of exposure and intensity for this procedure under simplified physical conditions; it is reasonably confirmed by numerous fluorescent screen observations and x-ray photographs, some of which are reproduced. For the construction of x-ray equipment capable of automatically sorting out the cans containing heterogeneous substances, some experiments with photoelectric cells were performed; proposals for their industrial production are included. Food submitted to this examination is not adversely affected. (EURATOM)

23213 IMMUNOLOGICAL STUDIES ON SOMATOTROPIC HORMONE. C. Conti, L. Sereno, M. Negri, and O. Recchia. Folia Endocrinol. (Pisa), 14: 25-36(1961).

The time of disappearance of I^{131} labeled bovine somatotropic hormone (STH) in the rabbit's circulation, was investigated. The interrelations between STH and certain protein plasma fractions were studied in normal rabbits and in previously bovine STH immunized rabbits. A method is also described, which permits by the aid of labeled hormone, to demonstrate, in vitro, a possible anti-STH antibody movement in the plasma of human subjects previously treated with bovine ante-hypophyseal extracts, whose content in STH is very high. The time of disappearance of labeled STH is about 18 min in the normal rabbit. It is greatly influenced by a specific anti-STH antibody movement; in the animals in which a high anti-STH immune response was elicited, the period for disappearance of the hormone from the general circulation reached about 57 min. The electrophoretic patterns and radioautograms of the latter animals showed an apparent radioactive stripe corresponding to the gamma globulin and inter-gamma globulin zone which has a specific antibody function. It was furthermore possible to demonstrate the same electrophoretic data in the pattern of two patients with hypophysary dwarfism who were treated for a long period with bovine ante-hypophyseal extracts very rich in STH. No migration of the iodate hormone was observed in control-rabbits and normal human subjects, with the same technique. These results confirm again that acquired resistance of all animal species toward a heterologous STH preparation is strictly bound to plasmatic factors of immune nature. The increased time of disappearance from general circulation of the growth hormone in STH immunized animals is suggestive of the presence of vehicle-antibodies which, inhibiting the hormone seem to be able to keep it in circulation longer. (EURATOM)

23214 CELLULAR RESPONSE TO FRACTURE STUDIED WITH TRITIATED THYMIDINE. Edgar A. Tonna and Eugene P. Cronkite (Brookhaven National Lab., Upton, N. Y.). J. Bone and Joint Surg., 43-A, No. 3, 352-62(Apr. 1961).

An autoradiographic study of femoral-fracture repair using tritiated thymidine was made on 42 female mice, 5 weeks of age. Assessment of the periosteal labeling index was obtained from one hour to fourteen days after fracture. Results show that the initial proliferative response is seen in the periosteum and adjacent soft tissues sixteen hours after fracture. No increase in proliferation was observed at eight hours. The reaction was not limited to the fracture site but extended along the entire femoral diaphysis. The maximum increase of the labeled periosteal population (25.4%) was observed 32 hours after fracture. After this time, the size of the labeled population decreased with increasing time. The decrease was more apparent away from the fracture site, so that within 5 days of fracture the proliferative potential was similar to that of the non-fractured control femur. Fourteen days after fracture, the labeled

population of periosteal cells at the fracture site was still above the value of the controls. (auth)

23215 CLINICAL APPLICATION OF HYPOPHYSECTOMY WITH ^{90}Y. C. Bompiani, T. Alessandri, A. Fanucci, A. Loassess, and E. Marzano. Nuntius Radiol., 27: 85-111 (Feb. 1961).

Eight Y^{90} hypophyseal infixions were performed on (1) patients affected by tumors at the IV state and (2) patients suffering from endocrinopathy. Among the patients of group (1) there were observed: a case of operative death; 3 failures and 2 arrests of the disease with remission of the clinical symptomatology. One of these last cases was represented by a woman affected by a breast tumor with widespread metastases in the skeleton. A year after the intervention the patient showed satisfying clinical conditions. A therapeutic success was observed in the 2 subjects with endocrinopathy. A patient with acromegaly is still under observation; a case of malignant exophtalmos associated with severe diabetes died after the 5th month owing to a postoperative complication, in spite of the disappearance of both the exophthalmos and the metabolic disturbance. (EURATOM)

23216 RESEARCH ON THE DOSE DISTRIBUTION IN LOW DENSITY MEDIA. C. Bompiani. Nuntius Radiol., 27: 171-86(1961).

An experimental study of absorption and diffusion is reported. It is limited to absorbing media with a density below that of water, subjected to radiations from Co^{60}. Several dummies were used. It is shown that the decrease in absorption with depth of penetration is partially compensated by a reduction of the scattering. The graphs given seem reasonably accurate for homogeneous media while for heterogeneous absorbents the dose calculation is rather complex. (EURATOM)

23217 TECHNICAL AND ECONOMICAL ASPECTS OF DIFFERENT LEVELS OF STERILIZATION BY MEANS OF RADIATIONS. F. Fossati. Nuntius Radiol., 27: 261-9 (1961).

The physical, biological, and technical fundamentals of sterilization, disinfection, and disinfestation of sanitary materials (or of raw materials for sanitary purpose) by the use of gamma radiations or fast electrons are reported. The technical characteristics of up-to-date equipment are briefly reviewed and the costs are analyzed, in order to determine the conditions which permit their economical use. (EURATOM)

23218 EXPERIMENTS WITH GRID THERAPY WITH ACCELERATED ELECTRONS. C. Bompiani and A. V. Del Vescovo. Nuntius Radiol., 27: 270-5(1961).

Research was carried out to evaluate possible differences of the dose distribution under two grids with the same opening relation but with holes of different size. The results show that the only effective variation consists in the depth of the homogenization plane and of the position, within the absorber, of the volume of homogeneous irradiation. (EURATOM)

23219 A RAPID METHOD FOR THE RADIOCHEMICAL GROSS ANALYSIS OF HUMAN URINE. II. A ROUTINE ASSAY METHOD USING THE COPRECIPITATION ON THE BASIC PHOSPHATE PRECIPITATES. Jun Akaishi (Japan Atomic Energy Research Inst., Tokyo). Radioisotopes (Tokyo), 8: 159-65(Sept. 1959). (In Japanese)

A gross radiochemical urinalysis method is described, which utilizes coprecipitation of gross fission products with basic phosphates that are found in urine. The isotopes Pm^{147}, Zr^{95}–Nb^{95}, Ru^{106}–Rh^{106}, Sr^{90}–Y^{90}, Co^{60}, Np^{239}, Cs^{137}, and I^{131} are considered. Attention is given to coprecipitation factors in the presence of carriers, desorption of the coprecipitated radioactivity from the precipitate, and lower limits for the detection of Sr^{90}–Y^{90} activity. The method is compared with the wet-ashing process. (T.F.H.)

23220 A ^{90}Sr BETA-RAY THERAPY UNIT. Hiroshi Moriya, Akira Kikuchi, Toshio Katoo, and Yoshio Takahashi (Tohoku Univ., Japan). Radioisotopes (Tokyo), 8: 196-201 (Sept. 1959). (In Japanese)

A 30 mc Sr^{90} radiotherapy unit is described. The surface dose, the depth dose, and the radiation leakage are discussed. Tubes are used to concentrate the β dose on the desired area. Different tube sizes are used for various treatment areas and skin-source distances. (T.F.H.)

23221 BONE-MARROW DOSE PRODUCED BY RADIOACTIVE ISOTOPES. Edward Holodny, Heather Lechtman, and John S. Laughlin (Memorial Sloan-Kettering Cancer Center, New York). Radiology, 77: 1-11(July 1961).

The absorbed dose produced in active bone marrow by radium treatment of carcinoma of the cervix was measured in a wax and cork phantom containing a real skeleton and closely resembling the human body with respect to size, shape, density, and atomic number. Certain representative bones of the skeleton were fitted with miniature ionization chambers that measured the radiation dose produced by three arrangements of radium in cervix applicators of the Manchester type. The mean absorbed active marrow dose produced by radiation from a cervix applicator containing 87.5 mg of radium was 99.7 rads in forty hours. The mean absorbed dose for the smallest applicator, which contained 50 mg of radium, was 58.7 rads. The integral active marrow dose ranged from 1.04×10^5 gram-rads for the largest applicator to 0.61×10^5 gram-rads for the smallest. All exposures were forty hr each. Measured doses at points A and B in the pelvis and doses calculated by conventional dosimetry methods showed a close correlation, attributable to the short distances between these points and the sources. (auth)

23222 Co^{60} ISODOSE CURVES FOR 240° ROTATION, SHOWING DISPLACEMENT OF THE CENTER OF DOSE FROM THE CENTER OF ROTATION. Lillian E. Jacobson, George P. Koeck, William R. Hillsinger, and Mark E. Schwarz (United Hospitals of Newark, N. J.). Radiology, 77: 66-76(July 1961).

A method of obtaining isodose curves for rotation therapy with Co^{60} teletherapy machines by the use of films exposed in a Presdwood phantom and measured on a densitometer is described. Isodose curves were made for 240° rotation for a Picker C-3000 and a Picker C-1000 machine for fields varying from 6×6 cm to 17×15 cm. Curves are given showing the displacement of the center of maximum dose from the center of rotation and the displacement of the center of the 80% isodose curves from the center of rotation, for fields of different sizes with the C-3000 and C-1000 machines. The displacement varies from 1.8 to 7 cm for the C-1000 with a 55 cm source-axis distance (S.A.D.), and for the C-3000 with a 95 cm S.A.D. The displacement for the center of the 80% curves varies from 0.4 to 5 cm for 55 cm S.A.D., and to 4 cm for the 95 cm S.A.D. The displacement of the center of dose depends chiefly on the dimension of the field in the plane of rotation and is almost independent of the dimension perpendicular to the plane of rotation. Isodose curves for the C-1000 machine and a diaphragm setting of 10×10 cm are given for 360° rotation. The method of using the isodose curves for patient work is described. A table is given of the dose at the center of rotation in per cent of the maximum dose for

fields of different sizes. The calculation of dose to the tumor is based on that received by the center of rotation. (auth)

23223 EARLY RADIATION REACTION AND DYSBACTERIA SAMPLES IN RADIATION THERAPY OF FEMALE GENITAL CARCINOMAS. A CLINICAL EXPERIMENTAL STUDY OF THE PROBLEMS OF THEIR PROPHYLAXIS AND THERAPY. Helmut-Paul Kuemmerle and Rolf Seyboldt (Universitats-Frauenklinik, Tubingen, Ger.). Strahlentherapie, 115: 72-89(May 1961). (In German)

After a detailed presentation of the problems of the intestine-flora and the radiogenic tissue changes of the intestinal tract and after clarification of the connections between intestine-flora and the early reaction of the stomach-intestine-tract, a prophylaxis and therapy with bacteria lactis acidophilum is described. Clinical usage promises success. Finally the problem of a bacteriological confirmation of clinical results of this type is discussed again by means of bacteriological stool examinations. (auth)

23224 ANNOTATED BIBLIOGRAPHY OF STRONTIUM AND CALCIUM METABOLISM IN MAN AND ANIMALS. Miscellaneous Publication No. 821. R. H. Wasserman and C. L. Comar, comps. Agriculture Research Service, U. S. Department of Agriculture, Washington, D. C., Jan. 1961. 137p. $0.65(GPO).

References (1161) were selected primarily from English-language journal and report literature published since 1950. When readily available, abstracts were included. References are arranged in 7 major categories and 36 subcategories. Author and subject indexes are included. (D.E.B.)

23225 RADIOISOTOPE MEASUREMENT IN NUCLEAR MEDICINE. Frank H. Low. Cleveland, Picker X-Ray Corporation, 1960. 67p.

Sections are devoted to a definition of radioactivity, the characteristics of nuclear radiation, radiation detection, units of measurement, accuracy of measurements, purpose of pulse height discrimination, and the medical uses of radioisotopes. An appendix includes data on radioisotopes used in medicine and their decay curves, radiation shielding, statistics of radiation counting with a table of Chi square values, source activity and clinical calculations, and resolving time. (P.C.H.)

23226 LOS RADIOISOTOPOS Y LA RADIACTION EN LAS CIENCIAS BIOLOGICAS. 2nd Simposio Interamericano Sobre la Aplicacion de la Energia Nuclear Para Fines Pacificos, Buenos Aires, 1959. (Radioisotopes and Radiation in the Life Sciences. 2nd Inter-American Symposium on the Peaceful Application of Nuclear Energy, Buenos Aires, 1959). (Inter-American Nuclear Energy Commission, Washington, D. C. and Argentina. Comision Nacional de Energia Atomica, Buenos Aires). 248p.

The proceedings of the symposium were previously abstracted in Vol. 14 of NSA from the English version. Abstract numbers are 14: 21206-9, 21227-50, 21276, 21349-53, 21831, 21855-6.

23227 APPARATUS FOR APPLYING RADIOACTIVE THERAPY IN THE PELVIC CAVITY OF THE BODY. Ralph Stuart Clayton. British Patent 867,756. May 10, 1961.

A radioapplicator is designed for therapy in the pelvic cavity, particularly the female adult. The applicator consists of a supporting frame, at least one radioactive material carried by the frame, means for mounting radioactive material on the support, and means for attaching the support to the pelvis of a patient. The support is made of a radiation conducting material and carries a radiation absorbing shield means positioned so as to intercept laterally directed radiation and to shield the unaffected organs (urinary bladder and rectum). There is a bead filled bag which is mounted on the frame to prevent the small intestine from entering the field of radiation. Brackets are provided for securing the supporting frame to the bones adjacent the pelvis. The supporting frame consists of a spider, a central post slidably and rotatably carried by the spider, and a cross arm slidably and rotatably carried by the post and carrying the radioactive material supports. The radioactive material is detachably mounted on the inner sides of the supports. (N.W.R.)

Biochemistry, Nutrition, and Toxicology

23228 (BNL-5414) TRITIUM LABELED THYMIDINE (H^3TDR) ITS SOMATIC TOXICITY AND USE IN THE STUDY OF GROWTH RATES AND POTENTIALS IN NORMAL AND MALIGNANT TISSUE OF MAN AND ANIMALS. Eugene P. Cronkite, Victor P. Bond, T. M. Fliedner, Sven A. Killmann, and Joseph R. Rubini (Brookhaven National Lab., Upton, N. Y.). 1961. 40p.

A review is presented on the possible toxicity of H^3TDR used to label DNA in in vivo and in vitro studies of tissue growth. The influence of chromosomal replication on interpretation of autoradiographic data is discussed. It is concluded that it is not practical to compute the radiation hazard and that it should be established empirically with respect to lymphopoiesis, hematopoiesis, spermatogania, carcinogenic effects, embryonic effects, and genetic effects. Some experimental data on lymphocyte pyknosis, hematopoiesis, and cancerous cells are reviewed. (D.L.C.)

23229 (CEA-1856) CONTRIBUTION A L'ÉTUDE DU MÉTABOLISME DES PRODUITS DE FISSION RECHERCHES SUR L'ÉTAT PHYSICO-CHIMIQUE ET LE DEVENIR MÉTABOLIQUE DES SOLUTIONS DE RADIOCERIUM. (Contribution to Research on the Metabolism of Fission Products. Studies on the Physico-Chemical State and the Metabolic Fate of Radiocerium Solutions). André Aeberhardt (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 94p.

Thesis submitted to Univ. of Paris.

A study of the physico-chemical state of radiocerium in dilute solutions on the tracer scale, as a function of the pH of the solution, is described. The way in which this radioelement is transported in the blood is studied in vitro and in vivo, with reference to the ionic or colloidal state of the radiocerium used. The distribution of cerium among various components of the blood is studied by a new method of blood fractionation and by paper electrophoresis. Evidence of a cerium-globulin connection is shown in the case of ionic cerium. A study of the initial distribution of radiocerium in rats, after intravenous administration of ionic or colloidal solutions, shows considerable differences according to the physico-chemical state of the cerium injected. (auth)

23230 (LAMS-2526(p.15-20)) LONG-TERM RETENTION OF ZINC^{65} BY MAN. C. R. Richmond, J. E. Furchner, and W. H. Langham (Los Alamos Scientific Lab., N. Mex.).

Retention of Zn^{65} was followed for approximately 1 yr in 2 human subjects. Retention functions were resolved into 3 exponential components by a 704 computer method. The parameters that describe the retention functions were used to calculate equilibrium levels and maximum permissible

concentration values. A comparison was made of short-term and long-term retention. Data are tabulated. (C.H.)

23231 (LAMS-2526(p.21-4)) MODIFICATION OF ZINC^{65} ABSORPTION BY DIETARY ZINC INTAKE. J. E. Furchner, C. R. Richmond, and G. A. Trafton (Los Alamos Scientific Lab., N. Mex.).

Results are reported from experiments designed to test the effect of differing levels of Zn in the diet on the absorption of orally administered Zn^{65}. Data are presented graphically from studies on rats. Results suggest that Zn absorption from the gut is modified by the level in the diet. (C.H.)

23232 (LAMS-2526(p.25-33)) ESTIMATION OF MAXIMUM PERMISSIBLE CONCENTRATIONS OF RADIOISOTOPES IN WATER (MPC) FROM INTERSPECIES CORRELATIONS. I. COMPARISON OF ESTIMATED AND MEASURED VALUES FOR ZINC^{65} AND TRITIUM. C. R. Richmond, J. E. Furchner, and W. H. Langham (Los Alamos Scientific Lab., N. Mex.).

Data are presented on interspecies correlation between equilibrium retention levels of Zn^{65} and tritium. The data were used in estimations of maximum permissible concentrations of these ratioisotopes in water. (C.H.)

23233 (LAMS-2526(p.34-7)) RETENTION AND EXCRETION OF ORALLY ADMINISTERED CESIUM^{137} BY MICE. II. PREDICTION OF RETENTION AFTER CHRONIC EXPOSURE. J. E. Furchner, C. R. Richmond, and G. A. Trafton (Los Alamos Scientific Lab., N. Mex.).

Comparative studies were made on the predicted and measured retention of Cs^{137} by mice following chronic oral administration. Results indicate that retention patterns of acute exposures may be used for predicting equilibrium levels during chronic exposures. (C.H.)

23234 (LAMS-2526(p.38-42)) ENHANCEMENT OF CESIUM^{137} EXCRETION BY RATS FED POTASSIUM-SUPPLEMENTED DIETS. C. R. Richmond, J. E. Furchner, B. E. Cummins, and G. A. Trafton (Los Alamos Scientific Lab., N. Mex.).

A K-deficient diet caused increased retention of Cs^{137} in rats. The initial Cs^{137} burden in animals on a 5% K diet decreased by a factor of 100 in 50 days, whereas the time required for a similar reduction in the initial body burden of animals fed the basal diet containing 1% K was 80 days. At 20 days after injection, the Cs^{137} burden of animals maintained on the diet containing 5% K was half that of animals fed the basal diet. (C.H.)

23235 (LAMS-2526(p.43-7)) EFFECT OF STABLE CESIUM ON THE RETENTION OF CESIUM^{137} BY RATS. J. E. Furchner, C. R. Richmond, B. E. Cummins, and G. A. Trafton (Los Alamos Scientific Lab., N. Mex.).

The retention of Cs^{137} by rats was not decreased by the addition of stable Cs to the diet. Data are presented graphically. (C.H.)

23236 (LAMS-2526(p.48-55)) EFFECTS OF AGE, SODIUM DEPLETION, AND SODIUM REPLETION ON THE RETENTION OF SODIUM^{22} BY RATS. C. R. Richmond, J. E. Furchner, B. E. Cummins, and G. A. Trafton (Los Alamos Scientific Lab., N. Mex.).

Results are presented graphically from an investigation of the effects of age, Na depletion, and subsequent Na repletion on the long-term retention of Na^{22} by rats. All age groups retained Na^{22} tenaciously during a 40-day period on a low-Na diet. During this period, the younger rats appeared to retain more Na^{22} than older animals. After changing to a normal diet, Na repletion began and both groups lost Na^{22} at an accelerated rate. The younger animals appeared to lose Na^{22} more rapidly during the initial phase of the repletion period than did older animals. Ultimately, the younger group incorporated more Na^{22} in the slowest changing component. (C.H.)

23237 (LAMS-2526(p.56-60)) LONG-TERM RETENTION OF RUTHENIUM^{106} BY RATS. J. E. Furchner, C. R. Richmond, and G. A. Trafton (Los Alamos Scientific Lab., N. Mex.).

Data on the retention of Ru^{106} by rats, after intraperitoneal injection, were extended up to 400 days. Data are tabulated on biological retention functions and half-times. (C.H.)

23238 (LAMS-2526(p.78-88)) DETERMINATION OF TRITIUM BETA ACTIVITY IN MICROGRAM AMOUNTS OF NUCLEIC ACIDS FROM HeLa CELLS CULTURED IN AGITATED FLUID MEDIUM. D. F. Petersen, L. B. Cole, and P. C. Sanders (Los Alamos Scientific Lab., N. Mex.).

A simplified procedure is described for routinely counting tritium β activity in biological materials. Results are reported from studies on the metabolism of labeled thymidine and desoxycytidine involved in the synthesis of desoxyribonucleic acid in HeLa cells grown in an agitated fluid medium. A flow diagram is presented for the separation and quantitative determination of radioactivity in nucleic acid fractions. (C.H.)

23239 (LAMS-2526(p.89-94)) DEOXYPOLYNUCLEOTIDE SYNTHESIS IN PHOSPHORYLATING RAT THYMUS NUCLEI. D. F. Petersen, L. B. Cole, and V. E. Mitchell (Los Alamos Scientific Lab., N. Mex.).

Results are reported from studies using P^{32} as a tracer to determine the incorporation of P by phosphorylating rat thymus nuclei. Results indicate that thymidine was incorporated into DNA at approximately 4 times the rate of desoxycytidine, although the total amount of precursor introduced in the reaction mixtures was the same. (C.H.)

23240 (LAMS-2526(p.95-100)) PAPER CHROMATOGRAPHY OF NUCLEOTIDES IN MILDLY ALKALINE AQUEOUS SOLVENTS. D. F. Petersen and M. Magee (Los Alamos Scientific Lab., N. Mex.).

An investigation was made of mildly alkaline aqueous solvent systems consisting of various aliphatic amines for the chromatographic separation of purine and pyrimidine analogs. Data are tabulated from a systematic investigation of homologous series of primary, secondary, and tertiary amine carbonates and formates. (C.H.)

23241 (LAMS-2526(p.101-5)) A CONVENIENT FLASH DRYING APPARATUS FOR SMALL VOLUMES. D. F. Petersen and M. Magee (Los Alamos Scientific Lab., N. Mex.).

An all-glass flash drying apparatus is described which is suitable for the evaporation of small volumes of a variety of labile biological materials. (C.H.)

23242 (LAMS-2526(p.121-8)) VARIATION OF HUMAN POTASSIUM CONCENTRATION WITH AGE. E. C. Anderson and B. E. Clinton (Los Alamos Scientific Lab., N. Mex.).

Measurements were made of the γ activity of human subjects using the Humco I whole-body liquid scintillation counter. Results of 802 measurements were used for calculating the K concentration as a function of age. Data are presented graphically on variation of human body K concentrations with age and sex. (C.H.)

23243 (LAMS-2526(p.164-71)) CUTANEOUS ABSORPTION BY HUMAN SUBJECTS. I. STUDIES WITH SODIUM^{24} AND IODINE^{131}. M. A. Van Dilla, C. R. Richmond,

and J. E. Furchner (Los Alamos Scientific Lab., N. Mex.).

The feasibility was investigated of using a whole-body γ spectrometer to study cutaneous absorption of radionuclides by human subjects. Results are reported from measurements of I^{131} absorption following palmar application. One experiment with Na^{24} failed to show positive skin absorption. (C.H.)

23244 (LAMS-2526(p.291-7)) METABOLISM OF TRITIUM-LABELED PYRIDOXINE IN RATS. I. U. Boone, S. Cox, and A. Murray, III. (Los Alamos Scientific Lab., N. Mex.).

The metabolic relationship between isoniazid and pyridoxine is discussed briefly. Results are reported from studies on the metabolism of tritium-labeled pyridoxine in rats. (C.H.)

23245 (LAMS-2526(p.298-301)) ESTABLISHMENT AND MAINTENANCE OF CELLS GROWN IN AGITATED FLUID MEDIUM. P. C. Sanders and D. C. White (Los Alamos Scientific Lab., N. Mex.).

A procedure is described for establishing and maintaining stock cultures of cells by growing in agitated fluid medium. (C.H.)

23246 (LAMS-2526(p.364-71)) CLINICAL APPLICATIONS OF WHOLE BODY SCINTILLOMETRY. IV. TURNOVER RATE OF PROTEIN-BOUND IODIDE. C. C. Lushbaugh, D. B. Hale, and C. R. Richmond (Los Alamos Scientific Lab., N. Mex.).

Whole-body scintillation counting methods were used in studies on the whole-body retention of I^{131} after oral ingestion. Twenty-six normal subjects were studied, but only 15 completed the rigid counting schedule which demanded whole-body radioactivity measurements immediately on the day of ingestion of I^{131} and on the 1st, 2nd, 3rd, 4th, 7th, 10th, 14th, and 18th days following. A statistical analysis was made of I^{131} retention in the 15 subjects. Data are tabulated and results are discussed. (C.H.)

23247 (LAMS-2526(p.372-86)) ELECTRONIC MEASUREMENT OF CELLULAR VOLUMES. I. CALIBRATION OF THE APPARATUS. C. C. Lushbaugh, J. A. Maddy, and N. J. Basmann (Los Alamos Scientific Lab., N. Mex.).

An electronic particle counter, glassware with a 100-micron aperture, and a pulse height analyzing system were adopted for use in determinations of erythrocyte volumes. Data are graphed automatically and also printed on a computing tape recorder. A number of calibration studies are described. Typical data are presented for the blood of normal men, mice, rabbits, guinea pigs, chickens, and ducks. Analyses were also made on the blood of populations with very small cells, such as horses, goats, and cats, and populations with very large cells, such as birds and reptiles. Typical frequency distribution profiles are given for the erythrocyte number per cm of mouse, monkey, and normal man. Conversion factors and experimental data are tabulated. Applications of electronic measuring equipment in the diagnosis of anemia are discussed. (C.H.)

23248 (LAMS-2526(p.387-400)) ELECTRONIC MEASUREMENT OF CELLULAR VOLUMES. II. FREQUENCY DISTRIBUTION OF ERYTHROCYTE VOLUMES. C. C. Lushbaugh, N. J. Basmann, and B. Glascock (Los Alamos Scientific Lab., N. Mex.).

Electronic particle counters with attached pulse height analyzing system were used to study the frequency distribution of erythrocyte volumes in man and other animals. Variations that might prove useful in clinical or descriptive hematology were sought. A stylized population profile for circulating mammalion erythrocytes was drawn and analyzed mathematically. A second mathematical analysis was done on a 704 IBM computer. The results of spectral analysis of population profiles are tabulated for normal man, pathologic man, mouse, chicken, monkey, frog, toad, and horse. Results of these preliminary studies indicate that studies of the variation and characteristics of red blood cell population profiles as measured and analyzed electronically show promise for defining changes in red blood cell populations that commonly accompany various hematologic diseases. (C.H.)

23249 (TID-13025) THE BIOCHEMISTRY OF A NEW SULFUR MUSTARD, S-(DICHLOROVINYL)-L-CYSTEINE AND ITS RELATION TO APLASTIC ANEMIA. Progress Report No. 6. M. O. Schultze and J. H. Sautter (Minnesota. Univ., St. Paul. Inst. of Agriculture and Minnesota. Univ., St. Paul. Coll. of Veterinary Medicine). June 15, 1961. Contract AT (11-1)-364. 41p.

Aplastic anemia was induced in calves by feeding toxic amounts of trichloroethylene-extracted soybean oil meal or by intravenous injection of a sulfur nitrogen mustard, S-(dichlorovinyl)-L-cysteine (DCVC). The hematologic effects of the two compounds are the same, and there is evidence that DCVC is the toxic agent in the feed. The blood dyscrasia induced by DCVC is similar to that produced in calves by whole-body γ irradiation. Results are reported from a series of studies on the interaction of DCVC with biological systems and their components. DCVC labeled with C^{14} and S^{35} were synthesized and used in tracer studies on metabolism of DCVC in Escherichia coli, rats, and in a calf. The protective effect of L-phenylalamine against the toxic effects of DCVC was measured. Results are included from preliminary studies on the effects of DCVC on growth rate of the photosynthetic heterotropic protozoan Ochromonas danica. A list is included of publications by staff members during the period covered. (C.H.)

23250 (TID-13090) TUMOR IMMUNOLOGY. Final Report, February 1, 1953 through January 31, 1961. W. J. Nungester (Michigan. Univ., Ann Arbor). Contract AT(11-1)-70. 21p.

Experimental findings are reported from a series of studies on various aspects of tumor immunology. Data are included from clinical trials of rabbit anti-tumor serum as a therapeutic agent in cancer patients, measurements of anti-tumor properties of mouse tumor antisera prepared in rabbits, attempts to isolate an antigen specific for the Gardner 6C3HED mouse lymphoma, studies of procedures for preparing specific rabbit anti-Ehrlich mouse carcinoma sera, a search for naturally occurring macromolecular substances with specific anti-tumor actions, and a study of the penetration of macromolecular substances such as gamma globulin through capillary walls into tumor bearing tissues. As a result of these studies it was concluded that substances having a specific action on cancer cells are very likely to be macromolecules such as immune globulins or naturally occurring biological materials such as plant extracts, that neoplastic cells have antigenic materials not found in normal cells, that immunological differences between neoplastic and normal cells do exist, and that antibodies do not penetrate the non-inflamed capillaries of tumorous tissue. (C.H.)

23251 (UCLA-477) MEASUREMENT OF LIVER BLOOD FLOW IN ANIMALS WITH COLLOIDAL RADIOGOLD (Au^{198}). O. M. Meredith, William Coffman, Jane Post, and John Holmes (California. Univ., Los Angeles. School of Medicine). June 12, 1961. Contract AT-04-1-GEN-12. 20p.

The reliability and sensitivity of colloidal radiogold

measurements of liver blood flow in animals by external γ scintillation detection methods has been pursued for two years. During this period control measurements fluctuated sufficiently to justify recommendation that colloidal radiogold preparations intended for blood flow measurement should be tested by suitable bioassay procedure. Other evaluations performed examined various aspects of blood flow measurement. Estimates of liver blood flow appeared more consistent when determined with half-times for the exponential blood disappearance process instead of blood retention values. Half-times for liver uptake of colloidal radiogold agreed with those for blood disappearance such that either values might be used as an index of liver blood flow. Ether anesthesia had no effect upon liver blood flow during these studies upon rabbits. Experimental alterations of the liver blood flow demonstrated the sensitivity of the test for variation in blood flow. For example, total occlusion of the portal vein markedly affected the estimate for blood flow while severe acute carbon tetrachloride poisoning had no effect upon blood flow when tested by this method. (auth)

23252 (UCRL-9688) PREPARATION OF BIOLOGICAL MATERIAL FOR RADIOAUTOGRAPHIC STUDIES OF INTERMEDIARY METABOLISM. Vivian Moses (California. Univ., Berkeley. Lawrence Radiation Lab.). May 1961. Contract W-7405-eng-48. 30p.

The intermediary metabolism of many kinds of biological material may be studied by supplying the tissue with radioactive substrates and analyzing the reaction products by paper chromatography and radioautography. The preparation of the tissue in a form suitable for such study frequently presents difficulty. Several experimental approaches to this problem are discussed which have been applied successfully to the metabolism of tissues from widely differing organisms. (auth)

23253 BEHAVIOR OF I^{131} FOLLOWING ITS INHALATION AS A VAPOR AND AS A PARTICLE. D. H. Willard and W. J. Bair (General Electric Co., Richland, Wash.). Acta Radiol., 55: 486-96(June 1961). (HW-SA-2013). (In English)

The maximum thyroid uptake in mice occurred 20 to 30 hours after inhalation of I^{131}: 2.5% of total I^{131} inhaled as vapor and 1.6% of the total inhaled as insoluble AgI^{131}. This amount represented 60% of the total body burden. In sheep the maximum thyroid uptake occurred between 20 and 35 hours after inhalation, oral, subcutaneous, or intraperitoneal administration. Two to 7% of inhaled I^{131} appeared in thyroid compared with 40 and 60% of that given by other routes. The results with inhaled AgI^{131} particles emphasize the unusual properties of the body fluids in solubilizing relatively insoluble particles. (auth)

23254 METABOLISM OF ZINC-65. M. E. Rubini, G. Montalvo, C. P. Lockhart, and C. R. Johnson (U. S. Army Tropical Research Medical Lab., San Juan, Puerto Rico and Univ. of Puerto Rico School of Medicine, San Juan). Am. J. Physiol., 200: 1345-8(June 1961).

The absorption, deposition, and excretion of $zinc^{65}$ were studied in mice, rats, and dogs. When $zinc^{65}$ was fed to the animals it was poorly absorbed, but its long biologic half life made even the small portion absorbed physiologically significant. Absorption was obviated by feeding large quantities of nonradioactive carrier zinc. Injected $zinc^{65}$ chloride first was deposited, preferably in the pancreas, liver, and spleen, with only minor deposition in muscle and in the brain. Subsequently, a large proportion was transferred to bone. The chief means of excretion was in feces, presumably via pancreatic secretion. Injected nonradioactive zinc or treatment with 2,3-dimercaptopropanol (BAL), Versene, or cadmium ion failed to alter body burden significantly. Cadmium, however, decreased soft tissue $zinc^{65}$ deposition and increased accretion by the skeleton. Blood activity fell rapidly and less than 0.01% of the dose injected remained in the blood after 1 day. Renal excretion of $zinc^{65}$ rose as plasma concentration fell and clearance ratios in excess of 1.0 were noted, indicating probable renal secretion. (auth)

23255 THE UPTAKE AND TURNOVER OF S^{35} SULFATE BY LEBISTES. Harold L. Rosenthal (Washington Univ. School of Dentistry, St. Louis). Biol. Bull., 120: No. 2, 183-91(Apr. 1961).

The uptake of S^{35} sulfate from the water in which the fish swim is linear with time for male Lebistes under specific conditions of water composition, but the uptake is modified in fishes depleted or saturated with sulfate. The rate of uptake of S^{35} sulfate is logarithmically related to the activity of the isotope in water. These results are similar to that found for Ca^{45} and Sr^{90}, and suggest that the ion transport regulatory system is similar for all ions studied. The turnover time of S^{35} sulfate for most tissues approximates a biological half life of 600 days. (auth)

23256 STUDIES ON THE EXCRETION AND DISTRIBUTION OF Cs^{137}. V. EFFECTS OF THE ADMINISTRATION OF VARIOUS HORMONES OTHER THAN ADRENOCORTICOID (ENGLISH TEXT). E. Ogawa, J. Machida, S. Suzuki, and K. Shibata (Gunma Univ., Maebashi, Japan). Gunma J. Med. Sci., (Japan) 7: 291-6(1958).

Male dd-strain mice were injected subcutaneously with 1 μc/0.1 ml of Cs^{137}, and the effect of subcutaneous injection for 4 days of adrenaline (0.5 ml of 10^{-5} g/ml solution), noradrenaline (0.5 ml of 10^{-5} g/ml solution), testosterone propionate (0.5 mg), estradiol benzoate (0.1 mg), thyroxine (0.02 mg), and insulin (0.02 IU) on the excretion and distribution of Cs^{137} 96 hr after injection was studied. The excretion of Cs^{137} tended to decrease after adrenaline or estradiol benzoate injections, and to increase after insulin injections. It changed very little after the administration of noradrenaline, testosterone propionate or thyroxine. On the other hand, accumulation of Cs^{137} in the liver, muscle, kidney, testis, bone and blood tended to increase after the administration of adrenaline, noradrenaline or estradiol benzoate, and to decrease after insulin or testosterone propionate injections. Little change was observed after the administration of thyroxine. (Absts. Japan. Med., 1: No. 6, 1961)

23257 THE DETERMINATION OF LOCALIZED CONCENTRATION OF Pu^{239} IN BONE. J. A. Twente and W. S. S. Jee (Univ. of Utah, Salt Lake City). Health Phys., 5: 142-8(June 1961).

A microdensitometric technique of measuring localized concentrations of α-emitting radionuclides was used to determine the Pu^{239} in bone. The data obtained by microdensitometric scanning of quantitative autoradiograms shows close agreement with data obtained by the previously used technique of the visual counting of α tracks. The accuracy of the technique was verified by a comparison of the Pu^{239} content of a thoracic vertebral centrum determined microdensitometrically with the Pu^{239} content of an adjacent centrum measured radiochemically. The amount of Pu^{239} found microdensitometrically was 76% of that determined radiochemically. The average Pu^{239} concentration associated with haversian systems, periosteal surfaces, and endosteal surfaces of trabecular bone in a lumbar vertebra (from a beagle hound injected with 2.85 μc of Pu^{239}/kg 92 days prior to sacrifice) was, respectively, 0.30×10^{-5}, 0.54×10^{-5}, and 1.6×10^{-5} μμc per μ^2 of surface. The calculated average

localized dose rate delivered to bone tissue and marrow cells on the endosteal surface deposit is 40 and 60 rads per day. These rates are ten times the previously calculated average skeletal dose rate. (auth)

23258 STUDY ON THE EXCRETION OF P^{32} INJECTED SUBCUTANEOUSLY. II. RELATIONSHIP BETWEEN DOSE ADMINISTERED AND AMOUNT EXCRETED. M. Date (Hiroshima Univ.). Hiroshima Igaku, 7: 1937-40 (1959).

Five, 50, or 500 μc of P^{32} were injected into the subcutaneous tissue of mice. When less than 50 μc of P^{32} was given, the amount excreted was approximately proportional to the amount given. Pretreatment with nonradioactive P had little effect on this relationship. The proportions of P^{32} excreted directly from the subcutaneous tissue via the blood stream (λ_1) and from tissues with (λ_2) or without (λ_3) entering the metabolic cycle were almost the same regardless of the dose administered except that doses as large as 100 μc resulted in an increase of λ_3. This was considered to be due to the increase of radioactivity rather than of P itself. (Absts. Japan. Med., 1: No. 6, 1961)

23259 EXPERIMENTAL STUDIES ON THE EXCRETION AND DISTRIBUTION OF Cs^{137}. VII. EFFECT OF THE ADMINISTRATION OF SODIUM BICARBONATE. E. Ogawa, S. Suzuki, J. Machida, R. Fukuda, H. Hayashi, and K. Horikawa (Gunma Univ., Maebashi, Japan). Kitakanto Igaku, 9: 1100-4(1959).

When 0.1, 0.2, and 0.5 ml of 1.5% sodium bicarbonate were injected subcutaneously daily in male dd-strain mice, the excretion of Cs increased and there was a decrease in Cs in the muscle, kidney, liver, and blood, most marked after 0.5 ml. When 0.2 ml of 5 and 10% sodium bicarbonate were given intraperitoneally, there was no change in excretion or body distribution. After 0.2 ml of 1.5% potassium bicarbonate daily, the excretion and body distribution appeared unchanged. When 0.2 ml of 1.5% sodium carbonate was injected, the excretion was the same but the Cs concentration in the muscle, kidney, liver, and blood was slightly diminished. (Absts. Japan. Med., 1: No. 6, 1961)

23260 EXPERIMENTAL STUDIES ON THE EXCRETION AND DISTRIBUTION OF Cs^{137}. IX. EFFECTS OF THE ADMINISTRATION OF VARIOUS SALTS. H. Hayashi (Gunma Univ., Maebashi, Japan). Kitakanto Igaku, 9: 1109-16(1959).

When 3.2% sodium sulfate was injected subcutaneously (s.c.) into male dd-strain mice, some increased excretion and a decreased retention of Cs^{137} in the muscle, kidney, liver, and blood resulted. After s.c. injection of 8% sodium thiosulfate an initial increase in excretion but no other change was seen. When 5% sodium chloride was injected intraperitoneally (i.p.) a significant increase in excretion and a decrease in retention resulted. 1% sodium phosphate did not change the excretion and body distribution. The s.c. injection 1.9% lactic acid caused some increase in excretion with no change of body retention. The injection of Hartmann's solution had no influence upon the excretion or retention. When 5% sodium acetate was injected i.p. a significant decrease in excretion resulted but no change in retention in the muscle, kidney, liver, and blood was observed. When 3.8% and 10% sodium citrate were injected s.c. or i.p., Cs^{137} excretion was decreased particularly in the intraperitoneal route. However, the distribution in the muscle, testis, kidney, liver, bone, and blood was not changed. The s.c. injection of 10% sodium glucuronate did not affect excretion or retention of Cs^{137} in mice. (Absts. Japan. Med., 1: No. 6, 1961)

23261 STUDIES ON THE METABOLISM OF Zr^{95}. R. Fukuda (First National Hospital, Tokyo). Kitakanko Igaku, 9: 1139-48(1959).

The excretion and distribution of Zr^{95} in rats of the dd-strain weighing about 20 g, and the influence of $ZrOCl_2$, Ca-EDTA, Na citrate, Na-Ca citrate, BAL, $MgSO_4$, and starvation were studied. The concentration of Zr^{95} injected subcutaneously and intraperitoneally was high in blood at the 6th hour, and afterwards concentrated in the bones. Excretion was most striking on the first day, 3.1% in urine and 5.9% in feces, with a 4-day total of 16.2%. At the end of the 4th day the distribution of Zr^{95} was bone (11.7%) followed by kidney, blood, and liver in that order. When a large amount of $ZrOCl_2$ was used as a carrier, excretion appeared rather depressed, but when a small dose was used the opposite was true. After injection of EDTA intraperitoneally, excretion of Zr^{95} increased. Zr^{95} was slightly diminished in the bone and kidney, unchanged in the liver, and was increased in blood. Twenty-four hours after the oral administration of Ca-EDTA, increased excretion of Zr^{95} was noted. The bone and kidney showed decreased and the liver increased retention. The subcutaneous injection of 0.2 ml of sodium citrate did not change the excretion of Zr^{95}, although 0.4 ml caused suppression, with some increase in the bone, liver, and kidney, and decrease in the blood. Oral sodium citrate caused no changes in excretion in spite of decreased bone retention. When 0.8 ml of Na-Ca citrate was injected subcutaneously a 2-fold increase in excretion was noted. No effect on excretion was produced by the injection of BAL. When $MgSO_4$ was given orally 30 min after oral Zr^{95}, increased excretion and reduction of bone concentration resulted. During starvation the excretion of Zr^{95} was depressed and there was increased retention in the liver, but no change in the bone and blood content. (Absts. Japan. Med., 1: No. 6, 1961)

23262 EFFECT OF SEROTONIN ON ABSORPTION AND DISTRIBUTION OF CALCIUM-45 IN THE RAT. S. Garattini, E. Grossi, P. Paoletti, R. Paoletti, and M. Poggi (Università, Milan). Nature, 191: 185-6 (July 8, 1961).

Serotonin caused an increase in the absorption of Ca from the intestinal tract of rats. Data are tabulated from in vitro and in vivo studies. Acetylcholine and creatinine sulfate had no effect on the absorption or distribution of Ca^{45} in rats. (C.H.)

23263 BODY DISTRIBUTION OF SOLUBLE URANIUM COMPOUNDS IN RATS. Y. Mizutani (Nagoya Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1592-6(1959).

The distribution of uranyl nitrate introduced into the peritoneal cavity of 21 adult rats was measured by counting the β-rays emitted. Six hours after the injection of 200 mg/kg, the blood contained up to 10% of the total injected. Uranium in the blood then decreased gradually. Uranium deposited in the liver, spleen, muscles, and adrenal glands was approximately parallel to the concentration in the blood. In the kidneys, however, the uranium content increased, reaching up to 9% of the injected dose at 48 hr. At that time the bone showed a uranium uptake of 2% per gram of bone tissue. In the lungs a slightly increased uptake was observed, perhaps due to pulmonary congestion. (Absts. Japan. Med., 1: No. 6, 1961)

23264 A STUDY ON THE INDUSTRIAL CHROMIUM POISONING (AN EXPERIMENTAL STUDY WITH ^{51}Cr). Takashi Takeuchi (Osaka City Univ. Medical School).

Osaka City Med. J., 6: No. 1, 159-76(1960). (In English)

Tracer chromium-51 was administered through mouth and trachea, to guinea pigs, and a comparative study was performed concerning its invasion into a living body, its absorption, excretion, distribution and accumulation. The concentration of Cr^{51} in blood is lower in the case of oral administration than in the case of tracheal administration. In oral administration, Cr^{51} decreased comparatively quickly, but, in the case of tracheal administration, it was detected even ten days after administration. In both cases the movement of Cr^{51} to the bone and teeth was slight. In both cases, the concentration of Cr^{51} in the liver was high in the initial stage of experiment. It decreased in the spleen, and it tended to increase in the latter period. The concentration of Cr^{51} in the kidneys was higher in the case of tracheal administration. The amount in the stomach and intestines was large at the initial stage of experiment, then gradually decreased. The amount in the brains and muscles was extremely small in both cases, and it quickly disappeared. In the case of oral administration, the amount of Cr^{51} excreted in feces was very large, while that in urine was small. During the period of observation for ten days after administration, the total amount excreted was 90.6%, that into urine and feces was 18.7% and 79.8%, respectively. The reason for the large excretion into feces is that a large amount simply passed through the digestive organs. In tracheal administration, the amount of excretion in feces was far less than that into urine. As observed for ten days after administration, the total amount excreted was 95.0%, consisting of 67.0% into urine and 28.0% into feces. The amount of Cr^{51} absorbed in the body was 0.6% and 1.3%, respectively, in the case of oral and tracheal administration. (N.W.R.)

23265 SODIUM-DEPENDENT "TRANSPORT" REACTIONS IN THE CELL NUCLEUS AND THEIR ROLE IN PROTEIN AND NUCLEIC ACID SYNTHESIS. V. G. Allfrey, R. Meudt, J. W. Hopkins, and A. E. Mirsky (Rockefeller Inst. [for Medical Research], New York). Proc. Natl. Acad. Sci. U. S., 47: 907-32(July 1961).

The incorporation of amino acids into the proteins of isolated thymus nuclei is sodium-dependent. This dependence reflects the operation of sodium-specific transport or gate mechanisms which admit amino acids into the intranuclear pool. Amino acid transport into the cell nucleus has many attributes of an enzymatic reaction. It is specific for the L-isomer of the amino acids; it has a pH optimum at neutrality, and a temperature optimum in the physiological temperature range. Competition studies indicate that specific receptor sites are concerned with the transport of different amino acids. These sites can readily discriminate between the D- and L-isomers of the appropriate amino acids, but close structural analogues such as L-isoleucine or glycine can competitively occupy the sites involved in valine or alanine transport, respectively. The transport reaction appears to be energy dependent, since it is inhibited by agents which block nuclear ATP synthesis. Similar sodium-dependent transport mechanisms have been observed for thymidine, adenosine, and adenine uptake. However, orotic acid incorporation into nuclear RNA does not require sodium ions, nor is there any evidence for sodium dependent orotic acid transport. The nuclear requirement for sodium ions contrasts with the potassium dependence of cytoplasmic systems, and in living cells, the nucleus maintains a high Na^+ concentration. The origin of the nuclear sodium and its role in controlling protein and nucleic acid synthesis are discussed. (auth)

23266 EFFECTIVENESS OF DTPA IN REMOVING PLUTONIUM FROM THE PIG. Victor H. Smith, John E. Ballou, William J. Clarke, and Roy C. Thompson (General Electric Co., Richland, Wash.). Proc. Soc. Expti. Biol. Med., 107: No. 1, 120-3(May 1961).

A single intravenous dose of diethylenetriaminepentaacetate (DTPA) one hour after Pu administration resulted in excretion of approximately 90% of the plutonium. As compared with untreated controls, retention of Pu in the skeleton was reduced by a factor of 10 and retention in the liver was reduced by a factor of 30. Two pigs treated with 5 consecutive daily injections of DTPA excreted 11 and 19% of the Pu injected 60 days prior to treatment. (auth)

23267 EFFECT OF CHELATING AGENTS ON UPTAKE OF Ca^{45} AND Sr^{85} BY DEFATTED BONE IN VITRO. Joseph Samachson and Hilda Lederer (Montefiore Hospital, New York). Proc. Soc. Exptl. Biol. Med., 107: 429-34(June 1961).

The presence of chelating agents in buffered solutions affected the relative uptake of Ca^{45} and Sr^{85} by defatted bone powder. Strong chelating agents, like ethylenediaminetetraacetic acid and cyclohexanediaminetetraacetic acid, decreased the ratio of Ca^{45}/Sr^{85} uptake considerably in presence of Ca, Ca plus Sr, or Sr carrier. Citrate and adenosinetriphosphate had similar but weaker effects. No effect was shown by glucose, lactate, gluconate, bicarbonate, bicarbonate plus phosphate, glutamate, aspartate, borate, glycerophosphate, lysine or glutathione. Those compounds which showed no effect had stability constants for Ca of less than 3. Strong chelating agents also decreased the relative amount of Sr^{85} removed from defatted bone powder by exchange. Results indicate that natural chelating agents may be partly responsible for the low Ca^{45}/Sr^{85} uptake ratio by bone from serum compared with uptake from synthetic inorganic solutions and emphasize the difficulty of removing Sr^{85} from bone with chelating agents now available. (auth)

23268 DIET-INDUCED CHANGES IN THE EXCHANGE AND ACCRETION OF RADIOSTRONTIUM BY RAT SKELETON. S. H. Cohn (Brookhaven National Lab., Upton, N. Y.), S. Nobel, and A. E. Sobel. Radiation Research, 15: 59-69 (July 1961).

The administration of stable Ca or Sr to decrease the retention of radiostrontium by skeletal tissue has been employed by a number of investigators with equivocal results. The experiments were based chiefly on the carrier effect, the dilution of radiostrontium with stable Sr or Ca administered just prior to or immediately after the administration of the radiostrontium. A different approach was used to decrease the Sr^{85} retention. This procedure is based on the hypothesis that a monolayer of Sr salts will be bound to the reactive sites of binding on the surface of the inorganic bone crystal with greater force than will a subsequent layer of Sr salts, since Ca phosphate is less soluble than Sr phosphate. Accordingly, stable Sr was administered in the diet for periods ranging from 2 to 7 days prior to the injection of Sr^{85}. Similar use of stable Ca and Zr was also investigated. It was found that there was a decrease of 76% in the retention of Sr^{85} in young growing rats receiving a high-Sr diet for 7 days, as compared with animals fed a stock diet. The decreased uptake of Sr^{85} was reflected in a decrease of both the Sr exchange capacity and the Sr accretion rate of the skeleton. A high-Ca diet also produced a decrease in the Sr^{85}, but much less than a Sr diet, and a Zr sulfate-supplemented stock diet was a little more effective than the high-Ca diet. (auth)

23269 THE INFLUENCE OF DIETARY POTASSIUM ON THE RETENTION OF CHRONICALLY INGESTED CESIUM-137 IN THE RAT. R. H. Wasserman and C. L. Comar (New York State Univ. Veterinary Coll., Ithaca). Radiation Research, 15: 70-7(July 1961).

The influence of dietary K on the retention of chronically ingested Cs^{137} by muscle, liver, testes, femur, whole blood, and brain was determined by long-term isotope studies and a short-term double-tracer study with K^{42} and Cs^{137}. At 35 days, it was observed that a ninefold elevation in dietary K caused a twofold reduction in Cs^{137} retention. This is probably the maximum effect. Tissue K levels were not altered by dietary K levels. The pattern of Cs^{137} accumulation by the selected tissues at 1 day was different from that at 35 days. At 1 day, the levels of Cs^{137}, in decreasing order, were liver, muscle, testes, femur, whole blood, brain. At 35 days, the levels, in decreasing order, were muscle, liver, testes, brain, femur, whole blood. It was calculated that the Cs/K ratio of the tissues divided by the Cs/K ratio of diet varied almost proportionally with dietary K levels; a ninefold increase in dietary K caused about a fivefold increase in Cs/K ratio (diet → tissue). Therefore, it appears that the concept of discrimination factor has severe limitations in theoretical and practical application for this ion pair. In the short-term double-tracer study, dietary K decreased K^{42} retention but did not influence Cs^{137} retention. It was concluded that potassium does not effectively compete with cesium for membrane transport sites or intracellular binding sites. (auth)

23270 APPARENT INSTABILITY CONSTANTS OF 2-MERCAPTOETHYLAMINE COMPLEXES. Edward C. Knoblock and William C. Purdy (Walter Reed Army Medical Center, Washington, D. C.). Radiation Research, 15: 94-6 (July 1961).

The apparent instability constants of the MEA complexes of Zn, Co, Cd, and Cu were determined polarographically in a phosphate buffer of pH 7.4 and in a sodium bicarbonate solution. In these media, the Zn complex is least strong and the Cu complex most strong. These data are discussed in relation to the role of Zn in enzymatic oxidation. (auth)

23271 MICROSCOPIC METABOLISM OF Ra^{226} IN CANINE BONE AND ITS BEARING ON THE RADIATION DOSIMETRY OF INTERNALLY DEPOSITED ALKALINE EARTHS. R. E. Rowland (Argonne National Lab., Ill.). Radiation Research, 15: 126-37(July 1961).

By means of a comparison between the specific activity of radium hotspots and the specific activity of the blood plasma, it is shown that no significant discrimination against radium exists in the transfer from blood to bone in the adult dog. After its initial deposition in bone, a loss of radium occurs from both the hotspots and the diffuse distribution. This loss is postulated to be the consequence of a continual slow exchange of calcium between the blood plasma and the mineral phase of bone. This loss of Ra^{226} by exchange processes is of such a magnitude as to imply that, at least during the first year after its deposition, direct bone resorption is of little consequence in the removal of radium from adult canine bone. The existence of such a process is significant in any study of the relationship between radiation dose delivered to bone by alkaline-earth radioisotopes and the subsequent damage produced, for it indicates that the terminal dose rates may be considerably less than those which existed previously in identical locations. (auth)

23272 THE PHOSPHORILATION IN LIVER AND KIDNEY OF RATS TREATED WITH FRACTIONS OF HOMOLOGOUS HOMOGENATES OF ORGANS BELONGING TO IRRADIATED ANIMALS. P. Erede, F. Dürst, and P. Bistolfi (Università, Genoa). Sperimentale, 3: 66-76(1916). (In Italian)

Experiments were planned with the aim of detecting the fraction of the total homogenate responsible for the morphologic and biochemical mitochondrial lesions observed in normal animals. Nuclei, mitochondria, and supernatant liquid of the total homogenate were separated by fractionated centrifugation. Each fraction was administered to normal rats by peritoneal injection. It was seen that the nuclear and mitochondrial fractions did not induce any cellular damage (P/O dissociation, swelling, or changing of shape of the mitochondria). The supernatant fluid, which residuated after sedimentation of the mitochondria, was responsible for the cellular damage. (auth)

Fallout and Ecology

23273 (A/AC.82/G/L.579) STUDIES ON PLANT ACCUMULATION OF FISSION PRODUCTS UNDER SWEDISH CONDITIONS. I. PLANT ACCUMULATION OF Sr-90 IN POT EXPERIMENTS IN RELATION TO UPTAKE UNDER FIELD CONDITIONS. L. Fredriksson and Å. Eriksson (Sweden. Försvarets Forskningsanstalt, Stockholm). Mar. 1961. 19p.

Data are given on the accumulation of Sr^{90} through root uptake by 17 different plant species when grown in pot experiments with four different soils. On the basis of these data the root uptake of Sr^{90} under Swedish field conditions is discussed, and an assessment is made of the activities to be expected in different plant products per mc Sr^{90} per km^2 contamination of the topsoil. (auth)

23274 (A/AC.82/G/L.580) STUDIES ON PLANT ACCUMULATION OF FISSION PRODUCTS UNDER SWEDISH CONDITIONS. II. INFLUENCE OF LIME AND PHOSPHATE FERTILIZER ON THE ACCUMULATION OF Sr-89 IN RED CLOVER GROWN IN 29 DIFFERENT SWEDISH SOILS. L. Fredriksson, Å. Eriksson, and E. Haak (Sweden. Försvarets Forskningsanstalt, Stockholm). Mar. 1961. 30p.

Comprehensive data are reported from pot experiments concerning the influence of lime and phosphate fertilizers on the accumulation of Sr^{89} in the aerial parts of red clover, when grown in 29 different Swedish soils, each of them pretreated in four different ways in the field 6 years prior to the pot experiments. On the basis of these data the functional relationships between Ca and Sr in plant and soil are discussed. (auth)

23275 (A/AC.82/G/L.581) STUDIES ON PLANT ACCUMULATION OF FISSION PRODUCTS UNDER SWEDISH CONDITIONS. III. ACCUMULATION OF Sr-89 IN THE AERIAL PARTS OF DIFFERENT WEED SPECIES AT VARYING Ca-LEVEL IN SOIL. L. Fredriksson, B. Eriksson, and Å. Eriksson (Sweden. Försvarets Forskningsanstalt, Stockholm). Mar. 1961. 12p.

The influence of liming on the accumulation of Sr^{89} in the aerial parts of a number of weed species, grown on a naturally calcium deficient soil in pot experiments, was studied. Liming decreased the accumulation of Sr^{89} in all of the weed species used. At one and the same Ca content in soil great differences were found in Sr^{89} activity in the dry matter of the different weed species. (auth)

23276 (HW-SA-2021) BIOLOGICAL CONSIDERATIONS OF RADIOACTIVE WASTES IN STREAMS. R. F. Foster (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 1960. Contract AT(45-1)-1350. 7p.

Presented at the Eighth Symposium on Water Pollution Research in the Northwest, Portland, Oregon, November 15, 1960.

The hazards to populations from contamination of streams by radioactive wastes are reviewed. The potential

effects of radiation on man from drinking contaminated water, from eating foodstuffs which have been contaminated from the water, from the use of contaminated water for swimming or other recreational or occupational purposes, the effects on aquatic life either directly or through effects on its food supply or habitat, the effects on domestic animals and wildlife which use the contaminated water for drinking purposes or obtain food from it, and the contamination of crops through using the water for irrigation purposes are discussed. Factors affecting the established values for maximum permissible concentration of radionuclides in water are discussed. It is pointed out that there are about 20 radionuclides which are considered as potential contaminants of marine or aquatic organisms. These include those radioisotopes which result from the fissioning of U or Pu and those which result from neutron activation of stable elements. Characteristics of radionuclides which are potentially of biological importance in environmental systems and the metabolic pathways of these radionuclides are reviewed. The relation between nuclides in the water and in biological forms is described as a complex chemical exchange system in which there is an equilibrium established between the concentration of the nuclide in water and in the various biological forms, silt, and other exposed surfaces. The kinds and amounts of radioactive materials present in the organisms must be evaluated both on the basis of potential radiation effects to the organism and on the acceptability of the edible forms as food. (C.H.)

23277 (LAMS-2526(p.61-77)) RADIOACTIVITY IN CERVIDAE ANTLERS. H. Foreman, M. B. Roberts, and E. H. Lilly (Los Alamos Scientific Lab., N. Mex.).

The use of deer antlers as indicators of environmental radioactivity is discussed. It is pointed out that in its browsing the deer takes in foliage and brush representative of a large surface area and metabolically concentrates the radioactivity in the antlers. Data are presented on the total β activity and Sr^{90} content of specimens of deer antlers from various locations throughout the U. S. and Canada for each year from 1945 through 1958, and for 1 sample from 1935. Results indicate a rise in Sr^{90} in antlers over the years. It was concluded that total β counts are of limited value unless a very large series of samples is tested. (C.H.)

23278 (LAMS-2526(p.222-44)) CONTEMPORARY CARBON^{14} IN THE BIOSPHERE. E. Hansbury, V. N. Kerr, D. L. Williams, and F. N. Hayes (Los Alamos Scientific Lab., N. Mex.).

Measurements were made of levels of C^{14} in a variety of biological materials harvested two years after cessation of test explosions of megaton nuclear devices. Results are tabulated from assays of essential oils, old essential oils, citrus oils, and turpentine collected throughout the world. An attempt is made to correlate air and lemongrass oil levels of C^{14} activity from 1956 to 1960. The relationship of C^{14} levels of plants to that of the atmosphere, and the contribution of fall-out C^{14} to these levels are discussed. (C.H.)

23279 AQUATIC AND BIOLOGICAL FACTORS IN NATURAL WATERS. Louis A. Kurmholz (Univ. of Louisville, Ky.). Univ. Illinois Circ. 58: No. 83, Eng. Expt. Sta., Circ. No. 69, 65-71(July 1961).

Radioactive materials in natural waters originate from three general sources: natural radioactive materials in the surrounding terrain, fall-out from weapons tests, and radioactive wastes from hospitals, laboratories, and atomic energy installations. The biological hazard of a radionuclide must be determined on the basis of its requirements by the organism and the length of time it remains in the tissues. Radioactive materials may be accumulated by aquatic organisms in 3 ways: by ingestion along with water or food, absorption from surrounding media through body surfaces, or adsorption to the body surfaces. Several artificial radioactive materials are produced in reactor operations. These are in addition to naturally occurring ones and usually have short lives. The actual mechanisms by which radionuclides are incorporated into the various tissues of aquatic organisms are not clearly understood. (P.C.H.)

Radiation Effects on Living Tissues

23280 (AECU-4358(Suppl.I)) BIBLIOGRAPHY ON THE EFFECT OF PROTON AND DEUTERON IRRADIATION ON BIOLOGICAL MATERIAL. Marjorie Comstock (Brookhaven National Lab., Upton, N. Y.). Aug. 22, 1960. 2p.

References (22) are given to CLML July 1958 to 1959; Index Medicus Jan. to Aug. 1960; NSA July 1958 to July 31, 1960; and Zentralblatt für die gesamte Radiologie 1957 to 1958, and 1958 to July 1960. (P.C.H.)

23281 (AF-SAM-61-53) HEMATOLOGIC EFFECTS INDUCED BY PERIODIC EXPOSURES OF MONKEYS (MACACA MULATTA) TO GAMMA RAYS. Robert J. Young, George S. Melville, Jr., Henry Borella, and John E. Pickering (Texas. Univ., Austin. Radiobiological Lab. and School of Aviation Medicine, Brooks AFB, Tex.). Nov. 22, 1960. 11p.

Twenty-three monkeys (Macaca mulatta) were divided into four groups and exposed periodically to low doses of γ rays from Co^{60}. The irradiated groups received 154, 274, and 590 rep total dose which was divided into doses administered every four days for 40 exposures. The cellular elements of the peripheral blood, hemoglobin, and hematocrit values were sampled and enumerated at intervals post-irradiation. An analysis of variance was performed on the data from those animals surviving to 24 weeks postirradiation. These surviving monkeys re-established normal hematologic values by the end of the 24-week period. No statistically significant results were obtained for any parameter measured which would be interpreted as a radiation effect. (auth)

23282 (LAMS-2526(p.261-6)) DEPENDENCE OF RECOVERY HALF-TIME ON MAGNITUDE OF GAMMA RAY EXPOSURE. J. F. Spalding, T. T. Trujillo, and W. L. LeStourgeon (Los Alamos Scientific Lab., N. Mex.).

The recovery half-time (RT_{50}) from x and γ radiation exposures between 200 and 700 rads was determined for mice. Data are tabulated. (C.H.)

23283 (LAMS-2526(p.267-74)) INHERITANCE OF RADIATION-INDUCED DECREMENT IN ABILITY OF MICE TO WITHSTAND PROTRACTED GAMMA RADIATION STRESS. J. F. Spalding and V. G. Strang (Los Alamos Scientific Lab., N. Mex.).

Unirradiated offspring from 10 generations of irradiated male mice were able to sustain less protracted γ exposure that were control animals. The results of pooled analysis are tabulated. Results strongly suggest the presence of a genetic burden produced by an accumulation of recessive or sublethal mutants in the descendants. (C.H.)

23284 (LAMS-2526(p.279-81)) EFFECT OF CHRONIC GAMMA IRRADIATION ON LIFE SPAN OF RF MICE. I. U. Boone, L. T. Rivera, and T. T. Trujillo (Los Alamos Scientific Lab., N. Mex.).

Mean survival and life shortening data are tabulated for

mice exposed to acute divided doses and continuous low-level exposure to gamma irradiation. (C.H.)

23285 (LAMS-2526(p.282-6)) EFFECT OF SINGLE DOSES OF WHOLE BODY X IRRADIATION ON THE LIFE SPAN AND TUMOR INCIDENCE OF C57 BLACK MICE. I. U. Boone, L. M. Conklin, and L. T. Rivera (Los Alamos Scientific Lab., N. Mex.).

Data are tabulated from studies on the effect of single doses of whole-body x irradiation on the life span and incidence of tumors in C57 black mice. (C.H.)

23286 (NP-10297) PHARMACOLOGICAL STUDIES ON IRRADIATED ANIMALS. X. EFFECTS OF CELL-FREE SPLEEN EXTRACT TREATMENT ON HEMATOPOIETIC TISSUES OF IRRADIATED GUINEA PIGS. Report No. 5. F. Ellinger and T. Strike (Naval Medical Research Inst., Bethesda, Md.). 1960. 39p. (DASA-516,Pt.10)

Qualitative and quantitative histological and histochemical evidence is presented which indicates that cell-free saline spleen extracts modify radiation induced changes in the spleen and bone marrow of guinea pigs following exposure to an $LD_{75/20}$ of Co^{60} gamma radiation. Post-irradiation treatment with homologous or heterologous (mouse) spleen extract accelerates the natural recovery process of the spleen and bone marrow of guinea pigs, while the initial effect remains unchanged. Histological findings gave the impression that the accelerated recovery process is caused by a stimulatory effect of the spleen extract on stem cells. Histochemical studies indicate that spleen extracts also modify the radiation effect on the alkaline phosphatase staining cells of the spleen. Since homologous or heterologous extracts produce similar results, a common mechanism of recovery was postulated. Study of the temporal sequence of changes indicates that recovery processes in spleen precede those in bone marrow, thus indicating a "hierarchy" of events. The significance of the findings for biology and clinical medicine is discussed. (auth)

23287 (QMFCIAF-37-60) EFFECT OF X-IRRADIATION IN GUINEA PIGS FED A BASAL DIET OF BRAN AND OATS, WITH OR WITHOUT RAW BROCCOLI. Interim Report. Doris Howes Calloway, A. H. Munson, and Russell Hilf (Quartermaster Food and Container Inst., Chicago). Dec. 1960. 35p. (AD-248681)

Young male, guinea pigs were fed a basal diet of bran and oats, with or without a daily supplement of 50 gm of raw broccoli, for two weeks before and after exposure to 400 r of whole-body x radiation. Animals were killed sequentially for histologic and hematologic examination. Provision of broccoli resulted in improved nutriture, larger livers with higher stores of vitamin A and minimal fatty changes, and superior gonadal development. Following irradiation in both groups, decrements in body weight and food intake as well as the characteristic events of the radiation syndrome were seen. Broccoli supplementation of the cereal diet generally reduced the degree of distortion or delayed its appearance. (auth)

23288 (TID-13002) [THE INFLUENCE OF RADIATION IN ALTERING THE INCIDENCE OF MUTATIONS IN DROSOPHILA]. Progress Report on the Past Twelve Months and Renewal Proposal for the Period September 15, 1961 to September 14, 1962. (Indiana Univ. Foundation Research Div., Bloomington, Ind.). May 31, 1961. Contract AT(11-1)-195. 18p.

Results are reported from studies on the relation between the dose rate at which γ radiation from a Co^{60} source is delivered and its effectiveness in inducing lethal mutations in oogonia of Drosophila melanogaster. Results are included from preliminary studies on dose rate effectiveness of neutrons in inducing lethals in oogonia of Drosophila, the relation between the dose of x radiation and the frequency of non-disjunction in the germ cells of Drosophila females, and the genetic aspects of somatic damage induced by irradiation in Drosophila. Data are tabulated on the frequencies of recessive lethals induced with the X chromosome of Drosophila. A list is included of publications by staff members during the period covered. (C.H.)

23289 (USNRDL-TR-509) LIMITED EFFECTIVENESS OF ANOXIC ANOXIA IN PROTECTING AGAINST RESIDUAL RADIATION INJURY IN MAMMALS. J. S. Krebs and R. W. Brauer (Naval Radiological Defense Lab., San Francisco). May 15, 1961. 20p.

The protective effect of anoxic anoxia against residual biological effects of irradiation was measured and compared with the protective effect against acute injury. It was found that a degree of hypoxia sufficient to reduce the effective radiation dose for acute injury by more than half failed to protect significantly against residual injury. The protective effect of the hypoxia against chronic or repeated radiation injury was intermediate between that for acute and for residual injury. (auth)

23290 (USNRDL-TR-510) THE EFFECT OF HIGH PROTEIN DIETS ON RENAL HYPERTROPHY IN RATS FOLLOWING WHOLE-BODY IRRADIATION. F. Konishi, V. J. Rosen, and R. W. Brauer (Naval Radiological Defense Lab., San Francisco.). May 18, 1961. 20p.

The relationship between high protein intake and increase in kidney weight was investigated in rats exposed to a single dose of 375 rad of x radiation. Attempts were made to characterize the degree of renal hypertrophy and hyperplasia involved by employing irradiation as an inhibitor of cellular proliferation. Rats were fed a high protein diet and exposed to radiation at various points of the feeding regime. The high protein diet significantly increased kidney weight in all cases but the increase was not influenced by the dose employed, or time of administration. However, histological studies of the kidneys showed that irradiation reduced the incidences of abnormal tubular hyperplasia. The renal lesions also appeared much earlier than previously reported by other investigators. Rats fed high protein diets appeared to recover body weight loss from the irradiation at a faster rate than those fed a basal diet. A possible mechanism is briefly discussed. (auth)

23291 (USNRDL-TR-515) RESIDUAL RADIATION INJURY EVIDENCED BY IMPAIRED REGROWTH OF REALIMENTED HYPOCALORICALLY REARED RATS. H. W. Carroll and R. W. Brauer (Naval Radiological Defense Lab., San Francisco). June 21, 1961. 27p.

Hypocalorically reared rats were subjected to single exposures of x ray ranging from 400 to 700 rad, or to repetitive exposures of 200 rad in 4 doses spaced one week apart (total 800 rad). They were allowed to recover for a minimum of 7 weeks and a maximum of 6 months following the last exposure and then returned to an adequate caloric intake. Realimentation of the irradiated populations resulted in reduced regrowth when compared to non-irradiated realimented rats of the same age. The reduction in regrowth persisted regardless of radiation exposure patterns, realimentation patterns, or the recovery periods employed. Paired-feeding demonstrated that the regrowth reduction is primarily one of reduced nutrient utilization. G I tract shielding showed that injury to the intestinal region with impaired absorption is probably not the cause. It is concluded that the reduced regrowth of the irradiated realimented rats is a generalized deficiency of nutrient utili-

zation by the organs and tissues, perhaps mediated through the endocrines. (auth)

23292 (USNRDL-TR-517) RENAL HYPERTROPHY AND FUNCTION IN IRRADIATED AND NEPHRECTOMIZED RATS FED A HIGH PROTEIN DIET. F. Konishi and R. W. Brauer (Naval Radiological Defense Lab., San Francisco). June 26, 1961. 21p.

Male rats exposed to a total of 740 rads of x radiation, were subsequently fed a hyperprotein diet and unilaterally nephrectomized to investigate functional and compensatory regenerative capacity of the kidney as probable indices of residual radiation injury. The extent of compensatory hypertrophy after nephrectomy showed a significantly greater increase due to the hyperprotein diet but no effect by irradiation. Estimates of maximal tubular excretions of PAH, however, were significantly greater in the irradiated groups than in control groups when determined 3 weeks post-nephrectomy. Renal clearances of C_{IN} and C_{PAH} were significantly depressed after nephrectomy but not after radiation. Histological studies of the kidneys did not indicate renal damage by radiation except for an isolated instance of a renal neoplasm in an irradiated, nephrectomized rat fed a hyperprotein diet. The results indicate that radiation does not modify compensatory hypertrophy after unilateral nephrectomy but appears to increase the apparent functional capacity of the tubules. (auth)

23293 (USNRDL-TR-512) AORTIC ARTERIOSCLEROSIS IN THE DOG FOLLOWING LOCALIZED AORTIC IRRADIATION WITH ELECTRONS. S. Lindsay, C. Entenman, B. W. Shumway, E. E. Ellis, G. L. Geraci, and R. Skahen (Naval Radiological Defense Lab., San Francisco). May 24, 1961. 25p.

The inferior segments of the abdominal aortas of 15 dogs were irradiated at electron doses from 1000 to 9500 rads, and were examined histologically at intervals ranging from 2 weeks to 17 months following irradiation. Pronounced aortic arteriosclerosis developed and was sharply localized to the aortic segment irradiated. Except in one dog, radiation-induced arteriosclerosis was more pronounced on the dorsal than on the ventral aortic wall. There was no evidence that severity of aortic arteriosclerosis was related to the dose of irradiation or was increased with time following irradiation. The development of arteriosclerotic lesions of the aorta induced by electron irradiation was similar to that observed after x-irradiation and to that occurring naturally in old dogs. It is suggested that electron irradiation may have caused selective injury of the internal elastic lamina, which was then followed by intimal fibrous proliferation and formation of intimal plaques. (auth)

23294 (JPRS-4680) THE OPTIMUM TIME FOR TREATING RADIATION INJURY WOUNDS. Endre Kotai and Eva Csanyi. Translated from Honvedorvos, 13: No. 1, 80-4(1961). 5p.

Traumatic wounds of rats, received at the same time as whole-body radiation exposure, healed best when treated 3 to 6 hr after the injury. First aid before and after this period resulted in complications which are attributed to the effects of shock and infection. (C.H.)

23295 (JPRS-7198) MEDICAL RADIOLOGY. Translation of Meditsinskaya Radiologiya, Volume V, No. 8, 1960. 169p.

A translation of the entire volume is presented. Various aspects of ionizing radiation effects are discussed along with techniques for use of radioisotopes such as iodine, phosphorus, and gold. Reviews of work related to radiology are included along with brief reports, critiques, and annals. (J.R.D.)

23296 (JPRS-9198) CHANGE IN RADIOSENSITIVITY OF ANIMALS AS A RESULT OF PREVIOUS X-RAY EXPOSURE. N. I. Nuzhdin, M. D. Pomerantseva, and N. N. Kuznetsova. Translated from Izvest. Akad. Nauk S.S.S.R., Ser. Biol., No. 6, 851-64(Dec. 1960). 22p.

A single previous exposure to x rays in sublethal doses can increase the survival of mice after subsequent exposure to a massive dose. A protective effect was observed from previous doses of the order 50 to 250 r 14 days before exposure to 600 r. The protective effect was manifested only in the survival and was not detected in a study of the body weight, weight of testicles, or peripheral blood picture. No definite conclusion as to the nature of the protective effect of previous exposure can be made at present. (auth)

23297 (JPRS-9433) PATHOHISTOLOGICAL CHANGES IN THE ORGANS OF WHITE RATS IN THE ORAL ADMINISTRATION OF RADIOSODIUM. A. A. Pinus. Translated from Arkh. Patol., 22: No. 10, 47-9(1960). 5p.

Na^{24}, administered in doses of 30 to 40 $\mu c/g$ to white rats, is toxic and often fatal and is accompanied by the development of typical symptoms of radiation sickness. Dystrophic symptoms in the testes are observed and multinuclear giant cells are often found in the lumens of the spermatic tubules. The administration of a dose of 12 to 20 $\mu c/g$ causes similar changes, although they are not necessarily fatal. The comparison of histological changes, caused by Na^{24}, with damage resulting from exposure of rats to x radiation in doses of 450 to 700 r, shows a similarity in the pathological changes in the organs. (auth)

23298 (JPRS-9477) CONCERNING BONE CHANGES IN CHRONIC EXTERNAL IRRADIATION. A. V. Grinberg and T. V. Orlova. Translated from Vestnik Rentgenol. i Radiol., 26: No. 2, 10-14(Mar.-Apr. 1961). 20p.

The hand bones of 100 persons occupationally exposed to the chronic effects of low-level radiation were examined roentgenologically. Among those examined were roentgenologists, x-ray technicians, and radiographers. Radio-induced changes found include osteoporesis, atrophy, osteosclerosis, and bone structure readjustments in various combinations and degrees. Initial bone changes were observed in persons working for less than 5 yr. Roentgenologists were affected more often than other members of the profession. Osseous changes were also observed in workers who had contact with radioactive substances. It was observed that radiation injuries of bone are possible without observable changes occurring in the skin. (C.H.)

23299 (JPRS-9735) INFLUENCE OF IONIZING RADIATION ON METABOLISM OF BRAIN PHOSPHOLIPIDS. O. A. Smirnova. Translated from Ukrain. Biokhim. Zhur., 33: No. 2, 208-13(1961). 9p.

After whole-body x irradiation of albino rats with a dose of 500 r, the content of lecithins and cephalins adsorbable by MgO decreases. The quantity of phospholipids is decreased even 24 hr after irradiation. After 6 days the changes are slight, and after 30 days the phospholipid content in the same fraction decreases markedly. A slight reduction in the sphingomyelin content is also noted. Changes in the lipid metabolism after irradiation have the nature of a prolonged process. (P.C.H.)

23300 (NP-tr-680) ON THE DENATURATION OF β-LACTOGLOBULIN BY THE RADIATION OF ULTRAVIOLET LIGHT. [PART] I. S. Sakamura and Y. Obata.

Translated by D. Jackson (U.K.A.E.A., Atomic Energy Research Establishment) from Nihon Nogei Kagaku-Kai Shi, 32: 667-70(1958). 12p. (Includes original, 2p.)

Crystalline β-lactoglobulin isolated from whole milk by a method based on that of Aschaffenburg showed a single boundary of electrophoresis in phosphate buffer solution of pH 6.7 on the alkalinity side of the isoelectric point, but the same in acetate buffer solution of pH 4.7 indicated the presence of two components which were considered to correspond to $\beta_1 + \beta_2$-lactoglobulin. Upon ultraviolet irradiation, β-lactoglobulin in the vicinity of the isoelectric point produces opalescence and forms a precipitate, but changes to yellow-brown on the alkalinity side. β-lactoglobulin in a solution of pH 6.7, in which it shows an electrophoretic single boundary, separates into at least two components upon being subjected to ultraviolet radiation. It shows a number of boundaries and becomes heterogeneous on the acidity side. It is believed that one of the causes for the electrophoretic heterogenisation is the participation of the production of ammonia from the protein molecule. The results of a sedimentation analysis showed little variation in S_t, and according to observations of sedimentation diagrams, it appears that a polydisperse system of denatured proteins exists. (auth)

23301 (NP-tr-684) INVESTIGATIONS ON THE DETERMINATION OF THE INTEGRAL DOSE IN X-RAY DIAGNOSTICS. E. Zieler. Translated by D. Hanley (U.K.A.E.A., Atomic Energy Research Establishment) from Fortsch. Gebiete Röntgenstrahlen u. Nuklearmed., 94: 248-60(1961). 31p. (Includes original, 11p.)

Methods of determining the integral dose in x-ray diagnostics were investigated. The energy entering the body was measured by attaching a flat ionization chamber to the distal side of the primary ray screen. At constant thickness of the ionization chamber in the direction of the cone of rays, the effective chamber volume is then proportional to the field size. Thus the product of dose rate and field size is directly shown by the ionization current. The energy emerging from the body is in principle also determined by ion dose measurement. Instead of at the body surface, measurement was carried out on a cone of 1 m radius, the center point of which was at the center of the irradiation entry field on the phantom. A deep-therapy generator, type Müller RT 250 with surface therapy hood HT 100 served as the radiation source. The dosage measured for the radiation emerging or scattering from the irradiated body was found to depend on incident dose, quality of radiation, field size, size of phantom, position of radiation entry field on the phantom, and phantom material and mode of construction. It was found that only a fraction of incident radiation energy, depending on radiation quality, irradiation geometry, and dimensions of the irradiated body, is absorbed by the body. This fraction may be as much as 90%, but in extreme cases may drop below 10% even if the cone of rays is completely obstructed by the body. (M.C.G.)

23302 HISTOGENESIS OF LUNG CARCINOMA IN MICE, INDUCED BY GAMMA RADIATION. Olive Gates and Shields Warren (New England Deaconess Hospital, Boston and Harvard Univ., Boston). A.M.A. Arch. Pathol., 71: 693-713(June 1961).

The response of bronchial epithelium and alveolar lining cells to long-acting radiation was observed. Continuous γ irradiation of the lung of mice for 3 to 10 months frequently produced bronchial epidermoid carcinoma. The histopathology of the lesion is described. Alveolar cells showed a marked response to radiation but failed to develop lesions recognizable as cancer. The minimum effective dose was not determined, but the estimated cumulative dose to the nearest viable lung tissue ranged from 90,000 to 460,000 rem, delivered at rates between 75 to 2000 rem per day. There was no consistent relation between dose levels and the development of carcinoma. The observations suggest that the use of radioactive agents which allow for fairly accurate measurements of a direct stimulus is a useful means of determining factors pertinent to carcinogenesis in man. (P.C.H.)

23303 THE INDIRECT EFFECT OF IRRADIATION ON EMBRYONIC DEVELOPMENT. I. IRRADIATION OF THE MOTHER WHILE SHIELDING THE EMBRYONIC SITE. Robert L. Brent and Mary M. McLaughlin (Jefferson Medical Coll., Philadelphia and Walter Reed Army Medical Center, Washington, D. C.). A.M.A. J. Diseases Children, 100: 94-102(July 1960).

The experiment described concerns the effect of irradiating a pregnant rat, while shielding the embryonic site on the ninth day of gestation, to determine to what extent the fetus is affected. The dose necessary for fetal malformation when the entire pregnant animal is irradiated is 25 to 100 r; 200 r being 100% lethal to the 9-day rat embryo. Only the external features of the term fetuses were examined, but no congenital malformations were seen, even though the type produced by directly irradiating this stage is quite obvious. In spite of 400 r, whole-body irradiation and 1000 and 1400 r partial-body irradiation on the ninth gestational day, no external teratology was observed in the fetuses. This would indicate that it is apparent that direct irradiation of the embryonic site is responsible for the teratologic effect of x irradiation. It is tempting to speculate that direct irradiation is wholly responsible at all other stages of gestation for teratology. This is probably correct, but the final evidence is not presented here. The fetal mortality was higher in the irradiated groups. The highest fetal mortality occurred in the 1400 r partial-body irradiation group. The radiation illness produced in the mothers, which includes a host of biochemical, physiological, and morphological changes, did affect the organism's ability to hold on to the fetus. Fetal growth was not affected in the low irradiation group, although those mothers which received the highest dose of irradiation did have smaller fetuses. Although the factors affecting maternal weight gain are multiple and impossible to single out, it is interesting that the 400 r group gained weight at the same rate as the controls, in spite of a higher maternal mortality rate and higher fetal mortality rate. The results reinforce the enigma of what factors are responsible for fetal resorption and fetal malformation. Are they quantitative differences of the same metabolic or physiological alterations or qualitatively different factors? This experiment offers little light on this problem except to add one more debilitating condition in the mother which alters some aspects of fetal growth and resorption while not producing teratology; this, in spite of the presence of a multitude of changes produced in the maternal organism. (auth)

23304 THE INDIRECT EFFECT OF IRRADIATION ON EMBRYONIC DEVELOPMENT. II. IRRADIATION OF THE PLACENTA. Robert L. Brent (Jefferson Medical Coll., Philadelphia). A.M.A. J. Diseases Children, 100: 103-8 (July 1960).

A method of irradiating placental tissue separate from embryonic tissue is described. Rat embryos and placental tissue were selectively irradiated on the 12th gestational day and examined on the 16th gestational day for growth retardation, fetal mortality, and congenital malformations. The maternal organism received no irradiation in this ex-

periment; only the placenta, embryo, or both. This is in sharp contradistinction to the previous paper in which the embryo and placenta were simultaneously shielded, while only the maternal organism was irradiated. The data indicate that irradiation of the placenta (while shielding the embryo and mother) did not alter fetal growth or fetal mortality. This was demonstrated by two separate results within this experiment, namely, irradiation of the placenta resulted in the same fetal mortality and fetal weight as the control embryos, and, secondly, irradiation of the entire embryonic site and the embryo alone resulted in embryos with fetal weights which could not be distinguished statistically. On the other hand, if only the mother was irradiated, fetal death resulted; and the incidence of resorptions increased with the dose rate. Thus, fetal mortality was increased by maternal irradiation and not affected by placental irradiation. These data lend further support to the conclusion that malformations produced by irradiating pregnant mammals are due primarily to the direct effect of ionizing radiation on the embryo and are not a result of placental injury (on the 12th day at least) or metabolic abnormalities induced in the mother by irradiation of the maternal organism. This is more apparent when one realizes that malformations can be produced with as little as 25 to 200 r (whole-body irradiation to pregnant mammals); yet in the two indirect experiments herein described doses of 400 r were used in the placental irradiation experiment and 400 to 1400 r, in the maternal irradiation experiment without obvious congenital malformations. Because of the nature of the experimental conditions, one cannot be certain of placental radioresistance at earlier stages of gestation. Furthermore, no broad general conclusions can be drawn regarding the responsibility of the placenta in the over-all picture of congenital malformations. (auth)

23305 RADIATION AND CANCER. C. C. Congdon (Oak Ridge National Lab., Tenn.). Am. J. Med. Technol., 165-71(May-June 1961).

Mechanisms involved in the induction of cancer by ionizing radiations are reviewed. (C.H.)

23306 FURTHER STUDIES OF A LYMPHOCYTIC HAEMOGRAM AND ITS RELATION TO LYMPHOCYTOPOIESIS. II. VARIATIONS IN MITOCHONDRIAL CONTENT OF BLOOD LYMPHOCYTES IN RELATION TO THE REGENERATION OF THE LYMPHATIC APPARATUS OF RATS AFTER TOTAL BODY X-IRRADIATION (ENGLISH TEXT). H. Imamura (Yamaguchi Medical School, Ube, Japan). Bull. Yamaguchi Med. School, 6: No. 3, 167-88 (1959).

In 35 male albino rats weighing around 200 g, changes in the number of the mitochondria in blood lymphocytes were observed after total-body x irradiation in a dose of 600 r. An acute decrease in number of lymphocytes and mitochondria per lymphocyte occurred shortly after irradiation and continued until the third week when the lymphatic tissues in the mesentery and spleen had recovered from the histological damage. This finding supports the opinion that a marked increase or decrease in mitochondria in the circulating lymphocytes may indicate an increased or decreased production and release of lymphatic cells. (Absts. Japan. Med., 1: No. 6, 1961)

23307 THE EFFECT OF IRRADIATION ON THE MAMMALIAN FETUS. Robert L. Brent (Jefferson Medical Coll., Philadelphia). Clin. Obstet. Gynecol., 3: 928-50 (Dec. 1960).

The experimental use of radiation in pregnant mammals and the exposure of human fetuses to radiation have demonstrated the approximate dose that results in growth retardation, death, and malformation of the fetus. The long-term results of irradiation, namely, genetic, tumorigenic, and life-shortening effects, have to be evaluated specifically for the fetus because of the possibility of altered fetal radiosensitivity to these long-term radiation effects. Suggestions are presented for reducing certain more remedial radiation hazards and placing others in their proper prospective. The importance of background radiation, fall-out radiation, and medical irradiation are presented. The quantitative importance of these sources of irradiation with the possible radiation effects to the fetus are discussed. 93 references. (auth)

23308 STUDY OF DESTRUCTIVE AND REGENERATIVE PROCESSES IN THE HAEMATOPOIETIC SYSTEM FOLLOWING IRRADIATION. Nina F. Barakina (Inst. of Animal Morphology, Academy of Sciences, Moscow). Folia Biol. (Prague), 7: 193-201(1961). (In English)

Primary changes in the hematopoietic organs after whole-body and local exposure to x rays showed no fundamental differences. The cellular elements were destroyed only after the direct action of radiation on these cells. No destruction of the cells occurred in shielded parts of the bone marrow and spleen. The cells of spleen irradiated in vivo and temporarily isolated (by ligature of the vascular stem) did not disintegrate. Destruction occurred only after renewing the function of the organ. On removing the irradiated spleen, no early destruction (within 4 to 6 hours) of the cells was observed. Bone marrow cells irradiated in vitro did not regenerate hematopoiesis in irradiated animals. The radiosensitivity of the cells of hematopoietic organs was basically the same in vivo and in vitro. The cells disintegrated, however, only on a functioning injured substrate. If different parts of the hematopoietic system were shielded, the rate of regeneration of the irradiated parts was higher, owing to the presence of an intact focus of hematopoiesis in the organism. Regeneration of the different forms of cells was much more rapid after the injection of isologous cells than after the implantation of heterologous tissue by the same technique. Intravenous administration was also more satisfactory than intraperitoneal administration for the regeneration of hematopoietic tissue in irradiated animals. The processes of differentiation of the cells did not basically differ from normal in the regeneration of bone marrow cellular elements in irradiated animals. (auth)

23309 EFFECT OF ADRENAL HORMONES ON RADIATION THYMOLYSIS. M. Pospisil (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Folia Biol. (Prague), 7: 217-19(1961). (In English)

It was demonstrated in adrenalectomized rats that whole body irradiation with a dose of 300 r increases the sensitivity of the thymus to the lympholytic action of cortisone and that the thymolytic effect of cortisone can be blocked in irradiated animals by the simultaneous administration of deoxycorticosterone. (auth)

23310 PATHOLOGICAL STUDY ON LATE EFFECTS OF INTERNAL IRRADIATION BY P^{32} ON THE HAEMATOPOIETIC TISSUE OF MICE. F. Hirose (Hiroshima Univ.). Hiroshima Igaku, 7: 1941-2000(1959).

P^{32} was given twice weekly (total 7 to 16 times) into the vein, peritoneal cavity, esophagus or trachea of adult dt-, ddF-, and ddN-strain mice. Recovery of hematopoietic function in the marrow appeared about 90 to 100 days after administration, and this function reached the normal level. Afterwards, however, some fluctuation near normal was noted. In a few mice granulocytic blood cells remained immature and leukemia developed. The spleen and lymph

nodes appeared slightly to moderately atrophic in most mice. The average rate of leukemia was 17.4%. In such cases the total dose of P^{32} was 14.1 to 98.0 μc. The survival period was between 175 and 602 days after the start of administration. The rate of leukemia was nearly parallel to the dose delivered. However, no leukemia was seen in the animals given less than 1.0 μc/g of P^{32}. Of 9 cases of leukemia, 4 were of undifferentiated, 2 myelogenic, 2 monocytic, and 1 was considered a lymphatic type. Leukemia was observed in 6 male and 3 female mice. Enlargement of the thymus was seen in 5 cases. In the undifferentiated type and monocytic type the thymus was enlarged. Edema and renal swelling were marked, compared with human leukemia. In the animals not suffering from leukemia there was an alveolar proliferation of young granulocytes near the arterioli in the marrow. This was rarely observed in the mice with leukemia. In leukemia, the sinuses of the spleen and marrow were reduced. Little or no proliferation of leukemic cells was seen in these sinuses, but in those of the lymph nodes there was definite infiltration. In the endocrine glands there were more or less atrophic changes and regressive degeneration. In the thyroid gland eccentric small folliculi with small cubic epithelial cells were observed. This tendency was exaggerated in the early appearing leukemia, but the change was not specific to leukemia. The leukemia in this experiment was similar to that seen in A-bomb survivors. (Absts. Japan. Med., 1: No. 6, 1961)

23311 INFLUENCE OF X-IRRADIATION ON THE GASTROINTESTINAL TRACT. II. CHANGE IN THE WEIGHT OF GASTROINTESTINAL TRACT AFTER WHOLE BODY IRRADIATION. M. Akamatsu (Hiroshima Univ.). Hiroshima Igaku, 7: 2755-70(1959).

Healthy adult mice were given a single whole-body dose of 300 r, 600 r, 1,000 r, 3,000 r, and 30,000 r. The weight of the digestive tract in the group given 300 r and 600 r decreased at the second day to a minimum, recovered to almost normal by the 5th day, and then decreased slightly about 7 to 8 days after irradiation. The group given 1,000 r and 3,000 r showed a rapid decrease, and all animals died in 3 to 4 days. The animals exposed to 30,000 r of x radiation all died within 1 day showing only a slight decrease in weight. The water content of the digestive tract changed parallel to its net weight. The fluctuation in weight was similar to the histological change in the intestinal epithelium, and was also related to the body weight. (Absts. Japan. Med., 1: No. 6, 1961)

23312 EXPERIMENTAL STUDY OF THE RADIATION HAZARD IN WHITE RATS CAUSED BY EXTERNAL SERIAL EXPOSURE TO Zn^{65}. M. Idaka (Kyushu Univ., Fukuoka). Igaku Kenkyu, 29: 4008-34(1959).

Twenty-four Wistar strain rats were exposed to γ-ray irradiation emitted from Zn^{65} for 182 days 24 hours daily. These rats were divided into 4 groups of 3 males and 3 females according to the time of irradiation: 15, 30, 60, and 182 days, respectively. There hematopoietic organs and reproductive organs were examined histopathologically. Peripheral blood drawn from the tail vein was examined in those exposed for 182 days. The red blood cell count showed a slight decrease from the 12th week until 172 days. The white blood cell count was 10,650/cu mm after 6 weeks and became under 10,000/cu mm at 14 weeks, a significant change chiefly due to decrease in the lymphocyte count. The spleen weighed 505 mg on the 15th day and 377 mg on the 172nd day after exposure. The testicle showed no atrophy but an increase in connective tissues. The spleen showed an atrophy of the lymph follicles and a fibrosis which were parallel to the duration of exposure. The bone marrow showed slight infiltration of fat cells. The ovary showed a decrease in primitive follicles and mature follicles. The liver showed fatty degeneration, vacuolar degeneration of liver cells and small round cell infiltration in the liver lobules and Glisson's capsule. (Absts. Japan. Med., 1: No. 6, 1961)

23313 CHANGE IN TISSUE RESPIRATION FOLLOWING X-IRRADIATION. K. Morishita (Tokyo Dental and Medical Univ.). Iji Koron, [No.] 1681, 19(1960).

Changes in the liver, brain, small intestine, bone marrow, spleen, and blood in healthy rabbits after x irradiation of 300 r were studied. One hour after irradiation the tissue respiration in the small intestine was increased to about twice normal. However, in the other organs no change or a very slight depression was noted. Three hours after irradiation the small intestine still showed some increase, but in the liver the tissue respiration appeared about half the normal. This may be due to a secondary product of indirect action of radiation. (Absts. Japan. Med., 1: No. 6, 1961)

23314 SUPPLEMENTARY STUDY ON THE BLOOD PICTURE IN X-RAY TECHNICIANS. [PART] I. Y. Kaga (Nagoya Univ., Japan). Nagoya Igaku, 80: 684-96(1959).

From 1952 to 1957, studies on the blood of x-ray technicians were made. Investigations were made of the yearly and daily variations in blood counts of these x-ray workers. Decreases were noted in erythrocyte count and hemoglobin content. Significant decreases were noted in a few, but improvement occurred. The decrease was directly proportional to the number of years engaged in work, but was unrelated to the age of the worker. The color index was in general hyperchromic. Leukopenia, unrelated to year examined, age of worker or number of years engaged in work was noted. Significant leukopenia was found in those engaged for many years and leukocytosis in those with a few years' experience. There was no relation to the age of the worker. In general, platelets showed a decrease unrelated to year examined, age, or number of years engaged in work. Erythrocyte count and hemoglobin content showed yearly variations similar to the controls, but the season in which minimal erythrocyte count and maximum hemoglobin content occurred did not coincide with that of the controls. The annual fluctuation in leukocyte count was small and a constant variation was not recognized. Erythrocyte and leukocyte counts varied daily as in the control, but hemoglobin content did not show a variation. It may be concluded that an impairment of the hemopoietic system occurs in x-ray workers. (Absts. Japan. Med., 1: No. 6, 1961)

23315 SUPPLEMENTARY STUDY ON THE BLOOD PICTURE OF X-RAY TECHNICIANS. [PART] II. Y. Kaga (Nagoya Univ., Japan). Nagoya Igaku, 80: 697-703(1959).

X-ray technicians were classified according to number of years engaged in work, and tests were conducted on cases selected at random from each of the groups. Lymphocyte mitochondrial index, refractive red granules, Demel's granules, reticulocyte count, Heinz bodies, bleeding time, capillary resistance, maximum erythrocyte resistance, urobilinogen excretion, serum vitamin B_{12} content, serum iron content, siderocyte, serum cholesterol, BSP, and renal function all showed normal values. Blood coagulation time, minimal erythrocyte resistance, CCF, Takata's reaction of serum, thymol turbidity test, hippuric acid synthesis, icterus index and Thorn's eosinophil test were abnormal. Urinary excretion of coproporphyrin and serum albumin were decreased in long-term workers; there was an increase in globulin with a tendency to a lower A/G

ratio. Serum iron binding capacity tended to be poor in long-term workers, and there was a more frequently abnormal galactose loading test. (Absts. Japan. Med., 1: No. 6, 1961)

23316 DISTRIBUTION OF DOSE IRRADIATED ON BODY SURFACE OF X-RAY WORKERS (ENGLISH TEXT). T. Kitabatake, H. Goto, M. Yoshida, and H. Iida (Nagoya Univ., Japan). Nagoya J. Med. Sci., 22: No. 3, 282-5(1959).

A film badge method and pocket chamber method were used. Doses were measured in the following areas: the frontal, right and left chest wall, both forearms, left knee, and upper and lower back region. During fluoroscopic examination, the upper extremity was the most noticeably exposed, while the back of the body was negligibly exposed. In fluorography, the chest and forearm were a little more exposed than other areas, which received less than 50 mr/w. Dose received was below the maximum permissible dose. (Absts. Japan. Med. 1: No. 6, 1961)

23317 ANALYSIS OF IRRADIATED DROSOPHILA POPULATIONS FOR MEIOTIC DRIVE. E. Novitski and G. D. Hanks (Oak Ridge National Lab., Tenn.). Nature, 190: 989-90(June 10, 1961).

Irradiated populations of Drosophila were analyzed for the existence of chromosomes or alleles represented in the gametes of a heterozygote with a frequency greater than the expected 50%. Such phenomena have been referred to as cases of meiotic drive when the basis is found in some aberration of meiosis. Chromosomes were tested that had received light doses of radiation each generation for about 200 generations. The genetic tests consisted of back-crossing heterozygotes for chromosomes derived from the irradiated populations and for stock chromosomes carrying mutant genes to the mutant stock in order to detect any deviation in the progeny from the expected 50% of each type. Of 1654 tests there were two instances in which the chromosomes derived from the irradiated population were recovered in significantly more than half the progeny, and where this deviation persisted after repeated testing. (C.H.)

23318 PREVENTION BY CYSTEAMINE OF RADICAL FORMATION IN BOVINE SERUM ALBUMIN BY γ-RAYS. D. Libby, M. G. Ormerod, and A. Charlesby (Royal Military Coll. of Science, Shrivenham, nr. Swindon, Wilts, Eng.). Nature, 190: 998-9(June 10, 1961).

The presence of 10% cysteamine was shown to reduce the intensity of the electron spin resonance spectrum of bovine serum albumin whether irradiation was carried out at 70°K, at room temperature in vacuo, or at room temperature in air. In every case the cysteamine reduced to half or less the number of radicals formed. Possible reaction mechanisms involved are discussed. (C.H.)

23319 IMPAIRMENT OF ERYTHROPOIESIS BY IRRADIATION. C. W. Gurney and Nancy Wackman (Univ. of Chicago). Nature, 190: 1017-18(June 10, 1961).

Investigations indicated that erythropoietin induces erythrocyte production by stimulating differentiation of primitive cells of the reticulum. An orderly wave of erythropoiesis was observed to sweep through the reticulum of mice with transfusion-induced polycythemia in response to a single injection of erythropoietin. Whole-body x irradiation caused reduction in the incorporation of Fe^{59} in the red cells of polycythemic mice given a single injection of erythropoietin. (C.H.)

23320 ABSENCE OF INDIVIDUAL CHROMOSOMES AND RADIATION SENSITIVITY OF BREAD WHEAT. D. Jagathesan and M. S. Swaminathan (Indian Agricultural Research Inst., New Delhi). Naturwissenschaften, 48: 384-5(May 1961). (In English)

Seeds of twenty different monosomics of bread wheat of the variety Chinese Spring were treated with different doses of x rays to determine LD-50. Dormant seeds with an embryo moisture content of 4 to 5% were irradiated with doses from 5000 to 50000 r. The seeds were sown immediately after irradiation. Germination and survival counts were made 15 days after sowing. The LD-50 rates found are tabulated and show that the monosomics are more radiosensitive than the disonics. Monosomics for D genome chromosomes have generally a higher LD-50 dosage in comparison with A and B genomes. (J.S.R.)

23321 EFFECT OF IRRADIATION ON THE HARD TISSUES OF NEWBORN RATS. T. Kasai (Tokyo Medical and Dental Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1251-65(1959).

The tail and lower extremities of newborn rats were exposed to a single radiation dose of from 600 r to 1,800 r, and the coccygeal bone and tibia were studied microscopically. The growth rate of these bones was appreciably diminished after irradiation in parallel with the exposed dose. In the control animals the growth rate of the coccygeal bone was greater than that of the tibia. When both bones were irradiated in the same dosage, growth was inhibited more markedly in the coccyx. In the non-irradiated animals the growth rate of the coccyx was greater in the distal part than in the proximal region. In irradiated animals depression of growth was exaggerated in the distal region. In the coccyx showing retarded growth the cartilaginous cells still showed appreciable changes even one month after heavy irradiation. In the control rats the formation of the medullary cavity resulting from erosion by vascular connective tissue was most marked in the proximal coccygeal segments. The erosion of this portion was markedly retarded after irradiation. The diminution of the rate of formation of the medullary cavity was in parallel with the irradiated dose. The changes in the tibia seen after irradiation were essentially the same as in the coccyx, except for the time of appearance. Automatic time-recording methods for detecting changes in the bone tissue will be more effective if periodic injection of acetic acid is made. (Absts. Japan. Med., 1: No. 6, 1961)

23322 EFFECT OF RADIATIONS ON THE NUCLEIC ACID METABOLISM IN MICE. III. COMPARISON OF X-RAY AND Co^{60} GAMMA-RAY ON NUCLEIC ACID CONTENT OF THE THYMUS, SPLEEN AND TESTES. G. Yamamoto (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1609-18(1959).

Male and female mice of C_3H strain were used. One group was irradiated by a single whole-body exposure of x rays (160 kvp) or Co^{60} γ rays of 50 r and 200 r under the same minute intensity. The other group was irradiated by x rays (150 kvp) 33.4 r in 3 min and 22 sec a day for 6 days, and γ rays (Co^{60}) 33.4 r in 22 hours a day for 6 days. The total dose of both cases reached 200 r. After irradiation the nucleic acid metabolism and the amount of nucleic acid was measured. In single whole-body irradiation of the same doses, x ray was more effective on nucleic acid metabolism in the spleen than Co^{60} γ-ray irradiation. The difference was exaggerated particularly in the case of 50 r exposure. However, no significant difference resulted in the thymus after x ray or Co^{60} irradiation. In a case of fractionated doses x ray also appeared more effective than Co^{60} γ ray. It was concluded that, as the dose rate was different

in x ray and Co^{60} irradiation, the time factor strongly influenced the effectiveness of irradiation. (Absts. Japan. Med., 1: No. 6, 1961)

23323 THE EFFECTS OF X-RAY ON THE MITOTIC INDEXES OF AH 130 AND AH 7974 ASCITES HEPATOMAS IN RATS. K. Takami (Yokohama Municipal Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1717-28(1959).

In two strains of rats the decrease in mitotic index was parallel to the radiation dose delivered. The recovery time also appeared to parallel the dose. These effects were more marked in the AH 130 than in the AH 7974 strains. In both, the mitotic index of the non-irradiated group and the slope of the mitotic index curve after irradiation were approximately the same, therefore the period of cell divisions was considered to be the same in both strains. In a comparison of the recovery curves the AH 7974 strain showed a slighter inclination than the AH 130. Therefore, it was concluded that a delay in prophase was more marked in the AH 7974 than in the AH 130. (Absts. Japan. Med., 1: No. 6, 1961)

23324 CHANGES IN CORPUSCULAR ELEMENTS OF THE BLOOD FOLLOWING RADIATION TREATMENT. K. Kaneta (Sapporo Medical Coll.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1941-4(1959).

One-hundred and thirteen patients treated from April 1955 to February 1956 were investigated statistically to study the changes in the corpuscular elements in the blood following one course of radiation therapy. Examination was made at the start and at the termination of irradiation. After radiation therapy reduction of white blood cell count, of percentage of lymphocytes, and of neutrophile leukocytes was seen. When blood transfusion was given, these changes were very slight and not significant statistically. However, if the number of cases in this group were as many as 50 it would presumably have been significant. The red blood cell count, hemoglobin and color index were within normal limits. The average number of nuclei was near the lower limits of normal. As the total irradiation dose increased, reduction of white count was increased. However, the regression coefficient was not significant. White cell count studied 2 months after the completion of radiation therapy was less than that at the start of therapy, but the difference was not significant. (Absts. Japan. Med., 1: No. 6, 1961)

23325 HISTOLOGIC STUDY OF BONE TISSUE AFTER IRRADIATION. O. Kagawa (Tokyo Medical and Dental Univ.). Ochanomizu Igaku Zasshi, 7: 1770(1959).

Histological studies of irradiated bones revealed that the cartilaginous tissue is most sensitive to x rays, with marked changes in the chondroblasts in the epiphyseal region. Similar changes were also seen in the articular cartilages which became more severe in the later stages. Changes in the vascular connective tissue appeared relatively early but this tissue was less sensitive than cartilage. These injuries of cartilage and vascular connective tissue caused failure of bone formation; with large doses of radiation, even the osteoblasts were injured. It is concluded that disturbed bone formation following irradiation is due mainly to injury of cartilage cells and not of osteoblasts. (Absts. Japan. Med., 1: No. 6, 1961)

23326 CHANGES IN THE BONE TISSUE AFTER INJECTION OF Sr^{90} AND P^{32}. A. Murayama (Tokyo Medical and Dental Univ.). Ochanomizu Igaku Zasshi, 7: 2078(1959).

Sr^{90} (0.4 to 4.0 μc/g) or P^{32} (2 to 8 μc/g) was injected into the peritoneal cavity in young male mice. They were followed from 3 to 10 days for Sr^{90} and from 2 to 42 days for P^{32}. Slides were made from the knee joints and stained with hematoxylin-eosin after decalcification. After injection of Sr^{90}, changes in the epiphyseal cartilage appeared relatively early. In the group injected with 2 μc disarrangement of the cartilaginous cells, shedding of cells from the production layer, and vacuolization of the cells in the mature layer were observed. Occasionally, even atrophy of the whole epiphyseal cartilaginous tissue was seen 3 days after injection. These changes progressed with time. About 100 days after injection there was a scarcity of cartilage cells and a thinning and atrophy of the joint cartilage. These findings were less marked in the case of external irradiation. The vascular connective tissue appeared considerably diminished 3 to 5 days after injection. This change was caused by poor formation of the trabecular layer, more definite in the epiphyseal region than in the joint. The secondary trabeculae also showed poor development with a decrease in osteoblasts and osteoclasts. The primary trabeculae were increasingly injured with time, and consequently also the secondary trabeculae. Even 70 days after injection there were few osteoblasts and osteoclasts near the injured trabeculae. The marrow also appeared destroyed and assumed a gelatinous structure. However, 44 days after injection signs of regeneration were recognized. After P^{32} injection, in mice given 2 μc/g of P^{32}, the epiphyseal cartilage was injured relatively early. The changes seen in the bone were quite similar to those caused by injection of Sr^{90}. However, this group showed a more severe reaction than that injected with P^{32}. (Absts. Japan. Med., 1: No. 6, 1961)

23327 RADIOSENSITIVITY OF SWINE FROM IRRADIATED PARENTAGE. James N. Shively, Howard L. Andrews, Harold J. Kurtz, Albert R. Warner, Jr., and Kent T. Woodward (Walter Reed Army Inst. of Research, Washington, D. C. and National Cancer Inst., Bethesda, Md.). Proc. Soc. Exptl. Biol. Med., 107: No. 1, 16-19 (May 1961).

LD 50/30 values for 12-week-old offspring from non-irradiated swine, from irradiated swine, and from an irradiated boar and non-irradiated sows were not significantly different. Survival times for progeny of the different parent categories were not significantly different and were within the usual range for midlethal irradiation. Other responses were similar in each group. (auth)

23328 THE EFFECT OF TOTAL-BODY X-IRRADIATION ON THE THYMUS AND THE NUMBER OF ITS CELLS. Ljerka Hofman, Veljko Stanković, and Nikša Allegretti (Inst. "Ruder Boskovic," Zagreb). Radiation Research, 15: 30-8(July 1961).

Three criteria were used for determining the effect of whole-body x irradiation on the thymus, thymic weight, total number of thymocytes, and the number of thymocytes per milligram of tissue. It was found that two independent cell populations exist in the thymus, one radiosensitive and the other radioresistant. The decrease in radiosensitive cells occurs more rapidly than the decrease in weight of the thymus at low x-ray doses, and the cell density therefore also decreases. The remaining radioresistant cells seem to be larger than the radiosensitive ones. Fourteen days after irradiation, there is complete restoration of cell density after exposure to x-ray doses at which one might suppose that some radiosensitive cells remain. Restoration of thymic weight and of total number of thymocytes, however, is not complete. When divided doses are employed 14 days apart (150 r × 2,300 r × 2, and 450 r × 2), there is a smaller decrease in thymic weight and in total number of thymocytes. Cell density, however, decreases to the same extent as after the first of the split doses. It may be concluded, therefore, that

repopulation during restoration originates partly from the larger radioresistant cells. (auth)

23329 THE EFFECT OF X-IRRADIATION ON PERIPHERAL BLOOD LEUKOCYTES IN NORMAL AND ADRENALECTOMIZED RATS. Abraham Hochman, Yehuda Feige, and Joseph A. Stein (Hebrew Univ.–Hadassah Medical School, Jerusalem). Radiation Research, 15: 39-44(July 1961).

The effect of x irradiation on the peripheral leukocyte count was investigated in normal and adrenalectomized rats. The lower half of the animal was exposed, while the upper half, including the adrenal area, was protected. The exposure ranged from 50 to 800 r. The decline in leukocytes after x-ray exposure was more pronounced in normal than in adrenalectomized rats and continued in normal rats for 48 hours longer than in adrenalectomized rats. The regeneration of leukocytes after irradiation was faster in the adrenalectomized group, and a higher cell count was reached there than in normal group. (auth)

23330 STUDIES ON THE MECHANISM OF RADIATION INACTIVATION OF MICROORGANISMS. VIII. INACTIVATION OF INTRACELLULAR MULTIPLY MARKED HAEMOPHILUS INFLUENZAE DEOXYRIBONUCLEIC ACID BY HIGH-VOLTAGE ELECTRONS. Johan H. Stuy (Yale Univ., New Haven). Radiation Research, 15: 45-58(July 1961).

Logarithmic growth phase cells of Haemophilus influenzae were exposed to high-voltage electrons. The decrease in biological activity of the cell desoxyribonucleic acid (DNA), as judged by reduction in transforming ability, was studied as a function of radiation dose. Inactivation curves for five single markers were of a semilogarithmic nature, but they had breaks at doses between 0.5 and 1.0 Mrad. The 37% survival doses varied from 0.16 to 0.285 Mrad. Removal of oxygen from the cells resulted in an increased radioresistance of their DNA, the dose-reduction factor being between 1.5 and 2.0. Addition of cysteamine to the suspension increased the DNA radioresistance by a factor of between 3 and 5. Doubly linked markers (on the same DNA molecule) displayed in vivo radiosensitivities which differed considerably from the sum of the sensitivities of the individual markers. In the case of a greater sensitivity it was concluded that radiation hits in between the markers simply unlinked the markers without much affecting their activity. In the case of a smaller sensitivity it was concluded that the markers were so close together that all or most hits in between them rendered both inactive. These conclusions were confirmed by experiments in which DNA was subjected to mechanical shear. Evidence was found for another type of radiation hit. These hits only inactivated the kanamycin resistance marker without unlinking the adjacent streptomycin and cathomycin (novobiocin) resistance markers. Markers, inactivated by this type of hit, are incorporated by recipient cells and replicated along with cell DNA. They remain inactive. (auth)

23331 EFFECT OF COMBINED ACTION OF IONIZING RADIATION AND CHEMICAL PRESERVATIVES ON MICROORGANISMS. PART I. VITAMIN K_5 AS A SENSITIZING AGENT. A. M. El-Tabey Shehata (Massachusetts Inst. of Tech., Cambridge). Radiation Research, 15: 78-85(July 1961).

Vitamin K_5 (4-amino-2-methyl-1-naphthol hydrochloride) increased the radiosensitivity of E. coli, M. radiodurans, P. fragi, and T. rosea. The magnitude of the sensitizing effect and the influence of oxygen varied with different microorganisms. The sensitizing action was demonstrated on these bacteria in the presence of nitrogen, but not in the presence of air, and only under aerobic conditions for the yeast. The presence of organic material during irradiation decreased the potency of vitamin K_5 against P. fragi. Also, the sensitizing action of the vitamin was more pronounced in an acid medium than in a neutral one. Several hypotheses were suggested as possible interpretations of these results. (auth)

23332 EFFECT OF DIETARY SUPPLEMENTATION WITH BROCCOLI ON X-IRRADIATION-INDUCED ENZYME CHANGES IN THE GUINEA PIG. Russell Hilf, Richard Adachi, and Gladys Eckfeldt (Quartermaster Food and Container Inst. for the Armed Forces, Chicago). Radiation Research, 15: 86-93(July 1961).

The radioprotective effect of broccoli supplementation was investigated in guinea pigs. ATPase and 5′-nucleotidase activities in spleen, lymph nodes, and adrenals were measured at various intervals after exposure to x rays. Broccoli prevented the postirradiation rise in these enzymes in the spleen. Serum acid and alkaline phosphatase, glutamic–oxalacetic transaminase, and glutamic–pyruvic transaminase activity decreased after irradiation, and no differences were observed between the two dietary groups. It would appear that the two spleen phosphatases studied could be used as an assay system for radioprotective compounds. (auth)

23333 DIFFERENCE OF BODY WEIGHT CHANGES OF CF #1 AND CFW STRAIN MICE EXPOSED TO WHOLE BODY Co-60 GAMMA IRRADIATION. Noritoshi Watanabe (Tokyo Univ.). Radioisotopes (Tokyo), 8: 166-70(Sept. 1959). (In Japanese)

The effects of single dose irradiations of strain CF#1 and CFW mice are studied. Co^{60} irradiations of 626, 730, and 834 r are applied to the mice. The changes in body weight of the mice are found as functions of irradiation dose, sex, and strain. (T.F.H.)

23334 THE INFLUENCE OF STRAIN AND SEX ON SUSCEPTIBILITY OF CF#1 AND CFW STRAIN MICE TO THE LETHAL EFFECTS OF Co-60 GAMMA IRRADIATION. Noritoshi Watanabe (Tokyo Univ.). Radioisotopes (Tokyo), 8: 171-6(Sept. 1959). (In Japanese)

The lethal effects of single dose irradiations of CF#1 and CFW strain mice are studied. Co^{60} irradiations of 626, 730, and 834 r are applied to the mice. The death rates and lethal doses are found, taking into account the effects of sex and strain. (T.F.H.)

23335 STUDIES ON THE EFFECTS OF RADIATION ON CHICK EMBRYOS. I. LETHAL EFFECTS USING A SINGLE LARGE DOSE IRRADIATION OF X-RAYS. Kenzo Okabe and Katsumoto Ueda (Defence Academy, Japan). Radioisotopes (Tokyo), 8: 177-84(Sept. 1959). (In Japanese)

Single-dose irradiations of 250, 500, 750, and 1000 r at 150 kev are applied to chicken embryos, at different stages of development between 4 and 16 days. The embryos are classified as to their survival times after irradiation, and as to their types of malformations and lesions. (T.F.H.)

23336 SPERMATOGONESIS IN RATS INTERNALLY IRRADIATED BY RADIOCESIUM-137. Takashi Kitabatake and Togo Yamaguchi (Nagoya Univ., Japan). Radioisotopes (Tokyo), 8: 185-9(Sept. 1959). (In Japanese)

Spermatogenesis is studied in rats after 5, 50, and 200 μc injections of Cs^{137}, for times up to 10 weeks after irradiation. The concentrations of spermatogonium, spermatocytes, spermatids, and sperm cells in the seminiferous tubules are given as functions of dose and time. (T.F.H.)

23337 EXPERIMENTAL STUDIES ON THE ^{45}Ca TURNOVER RATE IN BLOOD OF THE OLD AGED. Kunio Owada, Noboru Oshiro, and Mitsuru Horiguchi (Osaka City

Univ.). Radioisotopes (Tokyo), 8: 190-5(Sept. 1959). (In Japanese)

The turnover rate of Ca^{45} in the blood of old aged rats is studied. The concentration of Ca^{45} is measured as a function of time up to 2 hr after injection, and the turnover rates are deduced from the concentrations. The turnover rates in young adult rats are measured for comparison. (T.F.H.)

23338 RADIATION-INDUCED CHANGES IN THE GASTROINTESTINAL FUNCTION OF MICE AND THEIR PREVENTION BY CHEMICAL MEANS. Emanuel E. Schwartz and Bernard Shapiro (Albert Einstein Medical Center, Philadelphia). Radiology, 77: 83-90(July 1961).

Whole-body x irradiation with 600 r and higher doses caused impairment in the intestinal absorption of iodinated oleic acid in mice two days after exposure. Diminution in I^{131}-labeled serum albumin absorption was not observed even after 1400 r. Although irradiation also caused increased gastric retention, this was apparently not responsible for the decrease in fatty acid absorption. The administration of 2-mercaptoethylguanidine before irradiation, either orally or intraperitoneally, largely prevented the deleterious effect on absorption and gastric emptying. The significance of this functional impairment by irradiation and the preservation of life and function by chemical radioprotective agents are discussed. (auth)

23339 EFFECT OF IRRADIATION TO ADRENAL UPON CIRCULATING ADRENAL MEDULLARY HORMONE IN THE RAT. M. G. Griffith, J. Q. Griffith, Jr., M. B. Hermel, and J. Gershon-Cohen (J. Q. Griffith, Jr., Foundation for Medical Research, Philadelphia and Albert Einstein Medical Center, Philadelphia). Radiology, 77: 91-3(July 1961).

Irradiation to the adrenal in the rat in doses of 500 and 1000 r does not lower the level of circulating adrenal medullary hormone, as determined after stimulation by ether anesthesia and insulin injection. This is, therefore, confirmation of the observation based upon histologic studies, that the adrenal medulla is more resistant to irradiation than is the cortex. (auth)

23340 RADIOSENSITIVITY OF MALIGNANT ROUND-CELL RHABDOMYOSARCOMA IN THE NASAL FOSSA OF A CHILD. Jerome M. Vaeth and Thomas H. Piatt (Univ. of California School of Medicine, San Francisco). Radiology, 77: 94-6(July 1961).

A report of a malignant round-cell rhabdomyosarcoma in the nasal fossa of a child, with metastases to the cervical lymph nodes, is presented. Both primary and metastatic tumors were extremely radioresponsive but recurred despite thorough irradiation in the treated areas within six months. (auth)

23341 MODIFICATION OF IRRADIATION EFFECTS IN THE PIGEON, COLUMBA LIVIA. II. EFFECTS OF DELAYED BONE MARROW IMPLANTATION. Don H. Shaw and Halvor Vermund (Univ. of Wisconsin, Madison). Proc. Soc. Exptl. Biol. Med., 107: 414-20(June 1961).

Delayed bone marrow transplantation, in contrast to immediate transplantation, resulted in an increased average survival time of approximately 20 days for both homologous and heterologous marrow in lethally irradiated pigeons. Delayed homotransplantation resulted in only partial repopulation by donor derived erythrocytes. Chimera reversal occurred or the proportion of donor erythrocytes in circulation reached a maximum and then declined, while immediate homotransplantations resulted in eventual total repopulation by donor erythrocytes. In the heterologously treated pigeons in vivo agglutination occurred between the 4th and 6th day after heterotransplantation regardless of the number of days after irradiation. Delayed heterotransplantation did not result in elimination of all the host's erythrocytes, as was the case for the immediate heterotransplants. However, host-species-specific hemagglutinins were detectable at titers ranging from 8 to 64 with host cells, and sufficiently potent to produce in vivo agglutination. The host-species-specific hemagglutinins, which were present in the delayed heterotransplants, disappeared 15 to 20 days after the marrow implant and by the 30th day donor-species-specific hemagglutinins appeared in the circulation. In contrast, the host-species-specific hemagglutinins persisted until death in the immediate heterotransplants. Chimera reversal occurred in all 5 of the delayed heterotransplants which survived until the 45th day postirradiation. In contrast, the longest survival time after immediate heterotransplantation was 19 days and total repopulation by donor erythrocytes occurred in all animals which survived 10 days or longer. (auth)

23342 EFFECT OF IRRADIATION ON THE AGING PROCESS. M. Nakaizuma. Ronenbya, 3: 445(1959).

The lives of irradiated animals were shortened proportionally to the doses of radiation. Leukemia, malignant tumors, degenerative changes in the kidney, blood vessels, skin, and nails, anemia and cataract, which were believed to be late effects of radiation, are discussed in relation to the aging process. (Absts. Japan. Med., 1: No. 6, 1961)

23343 ACTION OF RADIATION ON ENZYMES. H. Hatano (Kyoto Univ.). Saihokaku Kagakukyokai Simposia, 9: 21-38(1959).

The inhibitory mechanism of radiation on enzymes is discussed from the results of irradiation by γ rays on crystalline urease, glutamic and alcohol dehydrogenases, and catalase, respectively. Inactivations of the enzymes in aqueous solutions were shown to be indirect actions of the reaction products between water molecules and γ rays. Protecting reagents against the inactivation were studied; thiol compounds were found to be efficient for the protection of reversible inactivations of sulfhydryl enzymes. Coenzymes of the dehydrogenases, such as diphosphonucleotide, were more radioresistant than apo-enzymes. A close relation was observed between the inhibitory damage of coenzyme molecules and changes in their ultraviolet absorption. (Absts. Japan. Med., 1: No. 6, 1961)

23344 EFFECT OF LOW-LEVEL CHRONIC IRRADIATION ON BLOOD. T. Fukuda, T. Sugawara, and T. Hashimoto (Kyoto Univ.). Sogo Rinsho, 5: 554(1959).

Hematological examinations have been done periodically since November 1955 on workers at a certain x-ray machine factory who have been under constant working conditions. Since July 1956 the dose of radiation received has also been measured. Radiologists and technicians at Kyoto University have been checked periodically since 1950. Even lower doses than the maximum permissible dose were found to cause a fall in RBC and exaggerated seasonal fluctuation. The RBC and WBC were somewhat abnormal in those with a past history of exposure. In those with abnormal WBC, the differential count was a good index of injury. In those with low RBC, the color index was helpful in determining whether or not the decrease was due to radiation. Measuring radiation exposure is an important means of protection against chronic radiation injury, but it must be remembered that the amount of radiation to one part of the body surface is not indicative of the total dose. (Absts. Japan. Med., 1: No. 6, 1961)

23345 HISTOLOGICAL CHANGES IN HUMAN INTESTINAL CELLS AFTER RADIATION THERAPY. R. de

Dominicis (Università, Florence). Sperimentale, 3: 77-96 (1961). (In Italian)

The investigation was carried out on 15 patients, who had been subjected to x-ray treatment for some extra-intestinal neoplastic affection, with doses varying from 200 to 5000 rad on the abdominal field. In 4 patients the biopsy was performed before treatment. The histological specimens included the mucosa and part of the submucosa. Unstained sections were examined by phase-contrast microscopy. The specimens taken before treatment consisted of sufficiently large samples of the intestinal mucosa, where the normal structure was perfectly evident. The post-radiation changes are similar to those observed in laboratory animals and depend on dose. They consist mainly of an atrophy of the intestinal villi and glands with a consequent flattening of the intestinal mucosa. On a more detailed investigation the folfowing alterations may be pointed out: pronounced damage of the caliciform cells which decrease in number and take a fusiform appearance as if they contained a smaller amount of mucus; evident modifications of the Paneth's cells which display a series of regressive changes, while their number becomes extremely low; alterations of the striated cuticle of the enterocytes which loses its delimitation from the remaining cytoplasma and becomes irregular and thick; a deformation of the enterocytes, some of which tend to become flat, while others take a dome-shaped aspect at their apical end or show drops of mucopolysaccharides in their cytoplasma; a decrease in the number of mitoses shortly after treatment and with small x-ray doses. (auth)

23346 INVESTIGATIONS OF THE EFFECT OF IONIZING RADIATION ON CELL MEMBRANES. II. CHANGES OF THE MEMBRANE POTENTIAL AND POTASSIUM CONTENT OF THE MUSCLE UNDER THE INFLUENCE OF X RADIATION. Hans-Dietrich Bergeder (Universität, Bonn). Strahlentherapie, 115: 90-104(May 1961). (In German)

The influence of ionizing rays on a tissue causes displacements of electrolytes. The cause for the radiation-induced displacement of ions is seen in a break down of the membrane as a barrier. A break down of energy-preparing metabolic processes, which can be taken into consideration, does not, up to the time of the start of the ion-displacements, allow itself to be proved; this follows—under circumstances after a temporary increase of certain metabolic processes—only later. The importance of certain electrolytes for the activity of enzymes makes it probable that electrolyte anomalies became active in a change of catalytic systems. Based on the findings, a reaction also of the radiation-induced ion displacement on the cell metabolism must be considered. It is therefore discussed, whether the sensitivity of a cell toward ionizing rays can also be conditioned by the structures, which are important for the ionized milieu of the reaction areas, and whether a varying susceptibility of the different membranes toward ionizing rays is available. A greater sensitivity to ionizing rays of biological membrane can be deducted from the electrical relations. Membranes lie within electrical fields which are conditioned through electrical double layers. The membrane fields are of such a strength (about 10^5 v·cm^{-1}), that on the ion couples, formed during the ionization, a considerable electric potential has an influence, which in the first place makes a recombination of the ion couples difficult and in the second place can lead through new loads to disorders in the membrane structure and therewith to changes in permeability. (auth)

23347 THE EFFECT OF X RADIATION ON THE PANCREATIC CELLS OF THE MOUSE DURING EMBRYONIC DEVELOPMENT. Nada Pipan (Universität, Bonn). Strahlentherapie, 115: 105-12(May 1961). (In German)

The exocrine pancreas is very radiation resistant in the differentiated state. In the embryonic organ a noticeable action is first produced with a dosage from 1200 r (80 kv). But the pancreas is more sensitive before the 15th embryonic day than it is later. In the early period the radiation inhibits the course of many mitoses. The interphase nuclei show with light damage a swelling of their nucleoli, in extreme cases nucleus pyknosis and cell death follow after a few days. The synthesis of prozymogengranula continues again in some cells after radiation rather normally; more often, however, it is stimulated and ceases only after very bad damage to the nucleus and the cytoplasma. If radiation of the pancreas cells in the pre-preparation phase of the granular formation succeeds, it frequently causes a lumping of the prozymogen substance, which lies on the nuclei in cap-like formation. With cytoplasma, the radiation damage prevalent in the basal cell region is observable. The nucleus and the formed prozymogengranula stay in the remaining cells, which then also perish. If the prozymogengranula formation has begun, the young pancreas cells are already very radio-resistant and further develop normally to columnar cells. (auth)

23348 MITOTIC ACTIVITY AND CYTOLOGY OF HUMAN BONE MARROW AFTER ACCIDENTAL EXPOSURE TO IONIZING RADIATION. T. M. Fliedner, E. P. Cronkite, V. P. Bond., and G. Andrews (Univ. of Heidelberg; Brookhaven National Lab., Upton, N. Y., and Oak Ridge Inst. of Nuclear Studies, Tenn.). p.458-67 of "Proceedings of the Seventh Congress of the European Society of Haematology." E. Neumark, ed. New York, S. Karger, 1960.

Studies of 5 men exposed to mixed neutron-γ radiation, resulting in severe depression of blood cell formation, indicate that there are significant abnormalities in the mitotic figures and cells during interphase. However, the percentage of abnormal interphase cells is not high. The presence of nuclear swelling, chromatin dissociation, nuclear and cytoplasmic maturation without nuclear division, atypical mitosis with chromosomal stickiness, fragmentation, and loss of chromosomes in the bone marrow within a few hours after radiation exposure indicate severe damage to the marrow. The dose in this study was not severe enough to cause significant karyorrhexis and karyolysis resulting in immediate cell death. Serial bone marrow examination within 3 days after uncertain radiation exposure may aid in a better assessment of the clinical situation and prognosis after radiation accidents. (P.C.H.)

23349 RADIATION HAZARDS OF SPACE EXPLORATION AND RADIOBIOLOGICAL PRINCIPLES INVOLVED. Titus C. Evans (State Univ. of Iowa, Iowa City). [Paper No.] 1756-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 12p.

The types and quantities of radiations encountered in space exploration are numerous and varied. Highest dose rates are expected in the trapped radiation (Van Allen) zones and from solar flares. Radiobiological factors involved are the total absorbed dose, dose rate, volume dose, and relative effectiveness of different kinds of radiation. The degree and type of biological damage vary, with changes in the above mentioned factors, from immediate and definite to late and indeterminant. It appears that biological hazards of radiations are not a limiting factor in comparison with the many other risks involved. (auth)

Radiation Sickness

23350 (AD-250387) PROTECTIVE EFFECTS OF CERTAIN NATURAL FOODS AGAINST WHOLE-BODY IRRADIATION. Report No. 7 (Progress), April 15, 1960 – July 15, 1960. William J. Darby (Vanderbilt Univ., Nashville. School of Medicine). Contract DA19-129-qm-1307. 8p.

Female Rockland Farm guinea pigs were divided into four groups of 15 each. Group A and B were fed a diet of bran and oats obtained from a local supplier. Group C and D were fed a diet of bran and oats furnished by the Quartermaster Food and Container Institute. In addition, Groups B and D received a mineral salts supplement. After a one month feeding period the only survivors were: one from Group A; four from Groups B and C; and 8 from Group D. The survivors were given 400 r (air dose) total body x-irradiation. By the end of the seventh day post-irradiation there were no survivors in any group. In order to evaluate the effects of the fat-soluble vitamins and alfalfa supplements an experiment was started using guinea pigs maintained on Briggs diet, local bran and oats supplemented with vitamin C, Quartermaster bran and oats supplemented with vitamin C, local bran and oats supplemented with fat-soluble vitamins and vitamin C, Quartermaster bran and oats supplemented with fat-soluble vitamins and vitamin C, local bran and oats supplemented with 20% alfalfa and vitamin C, and Quartermaster bran and oats supplemented with 20% alfalfa and vitamin C. (auth)

23351 (CRDL-TM-22-12) THE PATHOLOGY OF IRRADIATED MICE TREATED WITH TOLERANT HOMOLOGOUS, ISOLOGOUS AND NON-TOLERANT HOMOLOGOUS BONE MARROW. Edward Donati, George MacKay, John Petrali, Sherrill Ward, and Ludwig A. Sternberger (Army Chemical Research and Development Labs., Army Chemical Center, Md.). June 1960. 21p.

Mice were injected with living bone marrow elements of either tolerant homologous, isologous, or non-tolerant homologous type three days after exposure to 900 r of x radiation. The pathological findings are reported for mice that failed to survive. (C.H.)

23352 (USNRDL-TR-516) THE EFFECTIVENESS OF WATER-ELECTROLYTE REPLACEMENT THERAPY AND OF ANTIBIOTIC TREATMENT AGAINST ACUTE (3-5 DAY) INTESTINAL RADIATION DEATHS IN THE RAT. S. T. Taketa (Naval Radiological Defense Lab., San Francisco). June 22, 1961. 30p.

The administration of sterile 0.9% solution containing either NaCl or a mixture of NaCl, Na lactate, and KCl during the critical 2 to 5 days following irradiation had little protective effect. However, treatment with antibiotics during the same period definitely increased the number of survivors. Results suggest that both dehydration and bacteremia are causally related in the genesis of acute intestinal radiation deaths in the rat. A comparison between whole-body and abdomen-only irradiated animals given 910r showed that the therapeutic measures used were about equally effective against acute intestinal radiation death in both cases. The therapeutic measures were ineffective against deaths occurring primarily as a result of radiation induced injury to the hematopoietic system. (P.C.H.)

23353 (JPRS-9734) CONTENT OF FREE FATTY ACIDS IN THE BLOOD IN RADIATION SICKNESS. N. A. Nekovaleva. Translated from Ukrain. Bioknim. Zhur., 33: No. 2, 195-9(1961). 8p.

Total body irradiation of animals was given with RUM-3 apparatus. Dose for adult dogs amounted to 600 r; for puppies, 300 r; the dose rate, 9.3 r/min. The free fatty acids were determined by the dole method. It was found that the content of free fatty acids is higher before irradiation in males than in females. After irradiation the content of free fatty acids in the blood increases considerably both in sexually mature dogs and in puppies. It was concluded that the acids can play a definite part in the intoxication of the organism in radiation sickness. In puppies, which were given sunflower oil in their food, the content of free fatty acids in the blood before irradiation was greater than in puppies on an ordinary diet. After irradiation the content of the acids decreased. This may be explained by the protective effect of linoleic acid introduced in the food. (P.C.H.)

23354 THE INFLUENCE OF CERTAIN BIOCHEMICAL PREPARATIONS UPON THE SURVIVAL OF ANIMALS EXPOSED TO RADIATION AND THE BACTERICIDAL PROPERTIES OF THE SERUM. I. A. Pelishenko and V. V. Rudakov (Kirov Military Medical Academy, USSR). J. Microbiol., Epidemiol. Immunobiol. (U.S.S.R.) (English Translation), 31: 1247-52(1960).

It was shown in experiments in white mice that the administration of properdin alone as well as intravenous injection of properdin and bone marrow increased the survival rate of animals exposed to radiation. The bactericidal activity of the serum of animals exposed to radiation with regard to E. coli decreased. When properdin and bone marrow were given in combination with antibiotics the bactericidal activity of the serum of the animals exposed to radiation decreased to a lesser degree compared with the bactericidal activity of the serum in animals exposed to radiation and treated with antibiotics only. (auth)

23355 RADIATION SYNDROME AND VEGETATIVE NERVOUS SYSTEM (COMPILATION REPORT). G. Sitzlack and E. von Skramlik. Kernenergie, 4: 349-83(May 1961). (In German)

The complete symptoms of a radiation syndrome were subjected to a critical evaluation from the viewpoint of the contribution of the vegetative nervous system. From a large number of phenomena, principally the changes in the circulatory, respiration, digestive, and excretion systems, it is shown that as a result of the injury of the central nervous system the normal equilibrium between ortho and para sympathicus experiences a displacement. The mechanism of this displacement is unknown. 191 references. (tr-auth)

23356 THE EFFECT OF RADIATION-PROTECTIVE AGENTS ON PNEUMOCOCCUS INFECTION IN IRRADIATED MICE. S. Miyamoto (Nippon Univ., Tokyo). Nichidai Igaku Zasshi, 18: Suppl. 11, 2905-34(1959).

When cystine, ethyl alcohol, and sodium nitrate were injected into rats before x irradiation, death from pneumococcus infection was significantly decreased. Administration after irradiation was not effective. (Absts. Japan. Med., 1: No. 6, 1961)

23357 STUDY ON CHEMICAL PROTECTION AGAINST RADIATION INJURY. III. EFFECT OF BETA-MERCAPTOETHYLAMINE HCl (MEA), S-BETA-AMINOETHYL-ISOTHIURONIUM Br, HBr (AET), PENICILLAMINE, I-METHYL-2-MERCAPTOIMIDAZOL (MMI) AND 1-METHIONINE. T. Hashimoto (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1569-82(1959).

Sixty-day-old mice were given a single whole-body dose of 800 r or 600 r, after intraperitoneal injection of doses of radioprotective compounds near the LD_{50} or in a non-toxic

range. MEA, AET, and 1-methionine were protective while penicillamine and MMI tended to increase radiosensitivity. Penicillamine was protective at some dosages. Of the agents tested, MEA was most effective, and might be a practical agent for radiation protection. MEA and AET were effective in a dose of half LD_{50}. (Absts. Japan. Med., 1: No. 6, 1961)

23358 STUDIES ON CHEMICAL PROTECTION AGAINST RADIATION INJURY. IV. EFFECT OF RESERPINE AND 5-HYDROXYTRYPTAMINE. T. Hashimoto (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1583-91(1959).

Reserpine and 5-hydroxytryptamine (5-HT) were injected into the peritoneal cavity of mice before whole-body x irradiation of 800 r or 680 r. The survival rate 30 days after irradiation and change in body weight were noted. Reserpine showed a slight protective effect, not sex-dependent. 5-HT showed a protective effect in the female rather than in the male, in a dose of 4 mg/kg given 24 hr before x irradiation. In the group given 5 mg/kg of 5-HT, 30 min before irradiation, the protective effect depended on the radiation dose delivered. The protective effect of these agents may be due to depressed oxidation-reduction metabolism in the CNS. (Absts. Japan. Med., 1: No. 6, 1961)

23359 A NEW RADIATION THERAPY OF CANCER. Otto Joklik. Nuclear Energy, 244-53(June 1961).

A method of radiation therapy of cancer is described, in which gamma-convergent irradiation of the tumor is combined with the administration of chemical substances to neutralize free radicals formed by gamma radiation. Ozone treatment of the blood is used to obtain enzymatic activation of the catalase in healthy cells of the organism. This method permits application of very high radiation doses to the tumor. (auth)

23360 THE CLINICAL EVALUATION AND MANAGEMENT OF RADIATION ACCIDENT EXPOSURE PATIENTS. E. R. King (National Naval Medical Center, Bethesda, Md.). Radiology, 77: 77-82(July 1961).

A description of a practical approach to the problem of the clinical management of radiation disaster patients is offered. Important details involve adequate control of the admission room, as well as determination of the type of exposure and the radiation dose. Most of the treatment now available is supportive in nature. Good judgement in caring for such cases is of great importance. (auth)

23361 CHEMICAL PROTECTION AGAINST X-RADIATION IN THE GUINEA-PIG. Richard Wagner and Irving B. Joffe (Boston Floating Hospital; Tufts Univ. School of Medicine, Boston; and Boston Dispensary). Radiology, 77: 125(July 1961).

Chapman, Sipe, Eltzholtz, Cronkite, and Chambers first demonstrated the beneficial effect of glutathione injection in the x-ray induced mortality rate and weight loss in mice. The same effect was demonstrated in guinea pigs of 200 to 300 gm body weight on exposure to 200 to 250 r. Each animal was injected with 100 mg glutathione immediately before and after irradiation. (auth)

23362 INHIBITION AND AMPLIFICATION OF RADIATION EFFECTS BY CYSTEIN. Kurt Flemming (Universität, Greifswald, Ger.). Strahlentherapie, 115: 113-23 (May 1961). (In German)

The rise of cell permeability caused by uv light and x rays, which shows itself in erythrocytes as intensified cation exchange, cell-swelling, and haemolysis is inhibited by cystein. The cystein decreases also colloid-chemical and structure-chemical albumen changes caused by the given ray types. Perhaps the basic process of the protection of the cell permeability through cystein consists of an inhibition of the action of the rays on the albumen of the membrane. The radiation damage of the erythrocytes is of an oxidative nature, resulting from the intensified action of the oxygen. It is therefore supposed, that the protective action of the cystein against x rays is based on the reducing ability of the protective substance. The physical filter action through self-absorption also plays an important role in the protection action of the cystein against uv light, next to the chemical oxidation hinderance. The histamine formation in uv and x irradiated histidine solutions is not, as expected, impeded by cystein, but to the contrary is intensified. The possibility is considered that radiochemically formed, peroxide-like oxidation products of the cystein are causally involved in this intensifying action. The results were evaluated for a criticism of the histamine hypothesis of the biological radiation action. (auth)

23363 THE EFFECTS OF THE ESSENTIAL AMINO-ACIDS ON HAEMATOPOIETIC RECOVERY IN RADIATION INJURY. T. Nakano, T. Maeda, T. Okabe, and H. Mizuki (Yamaguchi Medical Coll., Japan). Yamaguchi Igaku, 8: 908-11(1959).

Tissue transplantation is effective in replacing the hematopoietic tissue destroyed after irradiation. Repeated doses of essential amino acids were given to stimulate regeneration of radiation-injured hematopoietic tissue. A definite effect not less than that of tissue transplantation resulted, but only when the protein synthetic mechanism had more or less remained in the destroyed tissue. (Absts. Japan. Med., 1: No. 6, 1961)

23364 PROTECTIVE EFFECTS OF LYMPHOCYTE TRANSFUSION ON RADIATION INJURY WITH SPECIAL REFERENCE TO THE RELATIONSHIP BETWEEN LYMPHOCYTES AND BONE MARROW CELLS. B. Osogoe and M. Sasaki (Yamaguchi Medical School, Ube, Japan). Yamaguchi Igaku, 8: 912-17(1959).

Young male mice of the Wistar strain were given total-body irradiation followed by transfusion of marrow cells or lymphocytes. Mice given irradiation with no transfusion served as controls. Marrow cell transfusion resulted in a marked increase of marrow cells, of leukocytes and reticulocytes in the peripheral blood and of nucleated cells in the spleen and thymus. Lymphocyte injection caused an increase of nucleated cells in the spleen, thymus, and mesenteric lymph nodes, and leukocytes in the peripheral blood with no change in marrow cell or blood reticulocyte count. (Absts. Japan. Med., 1: No. 6, 1961)

CHEMISTRY

General and Miscellaneous

23365 (AD-249439) ADDUCTS OF BORON COMPOUNDS. Fourteenth Quarterly Progress Report Covering Period October 1, 1960 to December 31, 1960. Harold C. Heachell (Delaware. Univ., Newark). Contract DA-36-034-ORD-2526RD. 11p.

An attempt was made to prepare dichlorophenylborane using phenylboronic anhydride and boron chloride, but the starting materials were recovered unaltered. The compound was prepared, however, using the reaction $Sn(C_6H_5)_4 + 2BCl_3 \rightarrow 2\ Cl_2B(C_6H_5) + Cl_2Sn(C_6H_5)_2$. Thioboronate esters were prepared from the reaction of the corresponding chloroborane and a mercaptan. The reduction of dichlorophenylborane was performed using lithium aluminum hydride and triethylamine in diglyme. (M.C.G.)

23366 (AD-249926) CHEMISTRY OF BORON. Status Report No. 3, Covering Period March 1 to May 30, 1960. F. A. Cotton (Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry). 7p.

The series of calorimetric determinations leading to the heat of formation of potassium fluoroborate was concluded. Efforts were directed toward establishing the order of acidity of boron trihalides. The reactions of dibutylbromoborine and dibutylchlorobromine with cobalt, manganese, and molybdenum compounds were investigated. The preparation of dibutylbromoborine is described. (M.C.G.)

23367 (AD-249927) CHEMISTRY OF BORON. Status Report No. 5, Covering Period September 1 to December 31, 1960. F. A. Cotton (Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry). 7p.

The product of the reactions between diethylborinic acid and cobalticcyanic acid was examined. Reactions involving the species $(n\text{-butyl})_2BM$ where M is K or Na and the methods of preparing the starting materials were investigated in the study of compounds containing boron to transition metal bonds. (M.C.G.)

23368 (ASD-TR-61-4) RESEARCH AND DEVELOPMENT OF HIGH TEMPERATURE STABLE ORGANOPHOSPHORUS COMPOUNDS. Charles F. Baranauckas, Richard D. Carlson, Edward E. Harris, and Robert J. Lisanke (Hooker Chemical Corp., Niagara Falls, N. Y.). May 1961. Contract AF 33(616)-7191. 173p.

A series of alkylene and arylenebisdiphenylphosphines and the corresponding bisphosphine oxides were prepared by modification of existing synthetic methods. Thermal testing by a weight loss and chemical change technique was carried out at 300 to 450°C in a nitrogen atmosphere. The arylenebisphosphines and bisphosphine oxides were more stable than alkylene, with the tri- and tetramethylene and the neopentylene being the most stable alkylene bridges. The aromatic series appeared to begin change by losing ring hydrogen with subsequent ring condensation. The alkyls all seemed to produce P–O–R structures or, in the case of phosphines, P–H and products derived therefrom. A thermal study of simple arylphosphines and arylphosphine oxides and sulfides yielded some clues to decomposition routes, which with the above data allow some tentative suggestions on mechanisms to be made. (auth)

23369 (K-1428) THE USE OF KARBATE ANODES IN FLUORINE CELLS. J. Dykstra and W. C. Paris (Oak Ridge Gaseous Diffusion Plant, Tenn.). Aug. 11, 1959. 14p.

Karbate anodes for fluorine cells were tested in production service at the Oak Ridge Gaseous Diffusion Plant. The service life of these anodes is compared to the service life of YBD carbon anodes. The effect on service life of various percentages of resin in the Karbate anodes is also discussed. The depolarization requirements, the voltage drops across the cells, and the costs for both types of anodes are reviewed and compared. Pertinent pictures and drawings are included. (auth)

23370 (NP-10307) SYNTHESIS OF INORGANIC POLYMER HIGH-TEMPERATURE FLUIDS. Progress Report No. 4, March 1961–May 1961. G. M. Nichols and W. J. Jones (Du Pont de Nemours (E. I.) & Co. Eastern Lab., Gibbstown, N. J.). June 13, 1961. Contract AF33(616)-7158. 14p. (ELab-B-2-31).

Investigation of phosphonitrilic chloride polymers stabilized against high-temperature polymerization by bonding to various metal halides was continued. Examples of metal halides which react with PCl_5 and NH_4Cl to give thermally stable $(PNCl_2)_n$/metal halide liquids were extended to include $SnCl_4$, $FeCl_3$, CuCl, and TlCl. $MgCl_2$, $CdCl_2$, $PbCl_2$, and AgCl failed to give stabilized products. Preparations of $(PNCl_2)_n/AlCl_3$, $(PNCl_2)_n/SbCl_3$, and $(PNCl_2)_n/ZnCl_2$ were further investigated. A new $(PNCl_2)_n/SbCl_3$ compound was obtained, and several $(PNCl_2)_n/ZnCl_2$ liquids of varying viscosity were prepared. Two new aryloxy phosphonitriles were prepared. Neither had satisfactory fluid characteristics, but they may serve as intermediates to more desirable fluids. (auth)

23371 (NP-10361) HIGH FIELD CONDUCTANCE RESEARCH; THE WIEN EFFECT OF URANYL SALT SOLUTIONS. (Technical Report No. 2). Andrew Patterson, Jr. and Joseph F. Spinnler (Yale Univ., New Haven. Sterling Chemistry Lab.). June 20, 1961. Contract Nonr 2667(00). 22p.

Solutions of uranyl nitrate and perchlorate of the order of 2×10^{-4}M exhibited a decrease in conductance on application of high electric fields. The decrease in conductance amounted to 1.3% at a field of 200 kV/cm and was many times greater than any possible experimental errors. The phenomenon was not observed in any other electrolytes thus far tested, including uranyl sulfate and fluoride. Both uranyl nitrate and perchlorate exhibited small positive Wien effects at 5°C, small negative Wien effects at 25° with multiple crossover of the zero conductance quotient axis as a function of increasing fields, and at 65° a sizeable negative Wien effect or decrease of conductance at all fields. It was also dependent on pH. It was concluded that the reaction $UO_2^{2+} + H_2O \rightleftharpoons UO_2OH^+ + H^+$ is responsible for the phenomenon in these solutions. Results of previous studies of the hydrolysis of the uranyl ion are summarized. (M.C.G.)

23372 (R-57-AGT-455) KINETICS OF BORON OXIDATION. M. D. Scheer (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). June 1957. 19p.

A study of the oxidation of powdered boron to boric oxide was carried out at 425 to 495°C. It is concluded that this heterogeneous process consists of the following successive steps: (a) The rapid formation of an imperfect boric oxide coat on each exposed boron particle, (b) slow reactant diffusion through the B_2O_3 glass imperfections, and (c) the healing of the glass imperfections, thereby effectively decreasing the rate to zero before all the boron is completely oxidized. (auth)

23373 (TID-13192) THERMODYNAMICS OF ASSOCIATION OF IRON(III) ION AND CHLORIDE ION IN AQUEOUS SOLUTION. Sister M. John Mark Woods, Patrick K. Gallagher, and Edward L. King (Wisconsin. Univ., Madison). 1961. Contract AT(11-1)-64. 38p.

Electromotive force, spectrophotometric, and calorimetric measurements were used to calculate thermodynamic quantities for the reaction $Fe^{3+} + Cl^- \rightarrow FeCl^{2+}$. For 1 M $HClO_4$ solutions, the following values were derived: $Q_1^0 = [FeCl^{2+}]/[Fe^{3+}][Cl^-] = 2.89$ to 2.95, $\Delta H_1^0 = 4.1$ to 4.4 kcal/mole, and $\Delta S_1^0 = 16.1$ to 16.6 cal/mole/deg. (D.L.C.)

23374 (AEC-tr-4055) JOURNAL OF INORGANIC CHEMISTRY. Translation of Zhurnal Neorganicheskoi Khimii, Volume II, No. 5, 1957. 364p. (PST-Cat.-82).

Thirty-five papers are included which treat a variety of topics in inorganic chemistry. Separate abstracts have been prepared for four of the papers, while two were previously abstracted in NSA. (D.L.C.)

23375 (AEC-tr-4055(p.276-9)) II. SEPARATION OF RADIOACTIVE RARE-EARTH ELEMENTS BY ION EXCHANGE. B. K. Preobrazhenskii, A. V. Kalyamin, and O. M. Lilova. Translated from Zhur. Neorg. Khim., 2: 1164-6(1957).

The use of the cationite KU-2 in a column for separating the rare earths was studied with ammonium lactate eluent at 90°C. Separation was excellent and much faster than for other ion exchange materials. The effect of temperature on separation is discussed. (D.L.C.)

23376 (AEC-tr-4055(p.280-5)) APPLICATION OF THE RADIOMETRIC METHOD OF ANALYSIS TO THE STUDY OF THE COMPOSITION OF PHOSPHOTUNGSTATES. Vikt. I. Spitsyn and N. B. Mikheev. Translated from Zhur. Neorg. Khim., 2: 1167-70(1957).

A radiometric method is outlined for determining the P/W ratio in phosphotungstates. The method was applied to sodium phosphotungstate prepared from solutions of varying P/W ratios, and the solid P/W ratios in all cases were found to be 1:12 with a maximum deviation of 2.5%, indicating an accuracy greater than that of chemical analysis. (D.L.C.)

23377 (AEC-tr-4055(p.321-30)) A STUDY OF THE REACTION OF SOLUTIONS OF URANYL SALTS AND SODIUM HYDROXIDE. B. P. Nikol'skii, V. I. Paramonova, and M. D. Morachevskaya. Translated from Zhur. Neorg. Khim., 2: 1194-1200(1957).

The results of a potentiometric study of the interaction of uranyl salts with NaOH in solution are presented. Solutions of $UO_2(NO_3)_2$ and UO_2SO_4 containing various concentrations of $NaNO_3$ and Na_2SO_4 were titrated with NaOH and the pH measured at time intervals from 12 hr up to a year. The titration curves indicate that equilibrium is reached only after a long period of time, from a few days up to a year. Two different sodium uranate precipitates of differing sodium content were observed. (D.L.C.)

23378 (AEC-tr-4059) JOURNAL OF INORGANIC CHEMISTRY. Translation of Zhurnal Neorganicheskoi Khimmi, Volume II, No. 9, 1957. 472p. (PST-Cat.-86)

A cover-to-cover translation of the Journal of Inorganic Chemistry, Vol II, No. 9, 1957 is presented. Twenty of the articles are covered by separate abstracts. (M.C.G.)

23379 (AEC-tr-4059(p.1-8)) THERMODYNAMICS OF THE DISSOCIATION OF HYDROGEN PEROXIDE IN AQUEOUS SOLUTIONS. K. Yu. Salnis, K. P. Mishchenko, and I. E. Flis. Translated from Zhur. Neorg. Khim., 2: 1895-9(1957).

A thermochemical study was made of the reaction of hydrogen peroxide with caustic soda in aqueous solutions at 10, 25, 35, and 50°C. The heat capacity of the system and the heat of reaction were determined. The dependence of the heat of reaction on temperature was calculated. The changes in isobaric potential and in entropy were also determined. Calculations were made of the composition of aqueous solutions of hydrogen peroxide as a function of temperature and pH. A value of −38.16 kcal/g-ion was obtained for the standard heat of formation of the perhydroxyl ion at 25°C. (M.C.G.)

23380 (AEC-tr-4059(p.9-21)) THE DISSOCIATION OF HYDROGEN SULFIDE IN AQUEOUS SOLUTIONS AT VARIOUS TEMPERATURES. T. A. Tumanova, K. P. Mishchenko, and I. E. Flis. Translated from Zhur. Neorg. Khim., 2: 1990-7(1957).

Investigations were made of the thermodynamic properties of hydrogen sulfide, sulfide, and hydrosulfide solutions at various pH values, temperatures, and ionic strengths. Potentiometric titrations of sodium sulfide were carried out with sulfuric acid and a glass electrode at temperatures of 10, 25, 35, and 50°C. The dissociation constants of hydrogen sulfide in the first and second steps were calculated from the titration data. The composition of the hydrogen sulfide solution at the various pH values, ionic strengths, and temperatures were determined. The thermal effects of the free energy and of the entropy changes were also calculated. (M.C.G.)

23381 (AEC-tr-4059(p.31-6)) THE SUBLIMATION OF GERMANIUM MONOSULFIDE. V. I. Davydov and N. P. Diev. Translated from Zhur. Neorg. Khim., 2: 2003-6 (1957).

Data was obtained on the equilibrium pressures of germanium sulfide at temperatures from 300 to 635°C. The equilibrium pressure was calculated from the loss of weight of the sample due to vapor effusion through a calibrated opening in an ampoule during a given interval of time. The GeS was prepared by sublimation in a stream of H_2S at 850°C. In the temperature range studied the vapor pressure changed from 10^{-4} to 2 mm Hg. (M.C.G.)

23382 (AEC-tr-4059(p.78-90)) THE THERMOCHEMISTRY OF COMPLEX COMPOUNDS. A. F. Kapustinskii and K. I. Vasilevskii. Translated from Zhur. Neorg. Khim., 2: 2031-8(1957).

The microcalorimetric method was developed to study the heats of formation of some bi- and tetravalent compounds of rhenium: H_2ReCl_4, H_2ReCl_6, $(NH_4)_2ReCl_6$, Hg_2ReCl_6, Cs_2ReCl_6, $HReO_4$, and NH_4ReO. The construction of the Schottky type dilatometric microcalorimeter was improved by adapting it to the study of reactions which proceed with the evolution of a gas phase. The heats of reaction of rhenium compounds with H_2O_2, NH_4OH, HNO_3, H_2O, $AgNO_3$, and CsCl were measured. From this data, the heats of formation of the compounds were determined. (M.C.G.)

23383 (AEC-tr-4059(p.99-107)) THE THERMAL STABILITY OF THE AMINO COMPOUNDS OF GALLIUM, INDIUM, AND THALLIUM. A. P. Kochetkova and V. G. Tronev. Translated from Zhur. Neorg. Khim., 2: 2043-8(1957).

A series of amines and ethylenediamines of Ga, In, and Tl were synthesized and their thermal stabilities studied. The compounds of Ga, In, and Tl chlorides with ethylenediamine were obtained by adding absolute methanol solutions of anhydrous ethylenediamine to the salt of the corresponding metal. The heating curves of the compounds were recorded in a current of dry nitrogen. The first endothermic effects on all three curves corresponded to

the splitting off of one molecule of ethylenediamine. The further decomposition of the compounds took place in different ways. Compounds of Ga, In, and Tl chlorides with ammonia were obtained in the action of dry ammonia on solutions of the compounds in ether. The decomposition of the amines on heating proceeds stepwise with the formation of lower amines. The Ga compounds were the most stable and the Tl compounds were the least stable. (M.C.G.)

23384 (AEC-tr-4059(p.108-22)) STUDY OF THE CONDITIONS OF PRECIPITATION OF URANYL FERROCYANIDE FROM AQUEOUS SOLUTIONS. V. G. Sochevanov, N. V. Shmakova, and G. A. Volkova. Translated from Zhur. Neorg. Khim., 2: 2049-57(1957).

A study was made of the properties of uranyl ferrocyanide and of the conditions for its precipitation. The assembly used for measurement of the polarographic properties of the compound and for amperometric titration is described. The effects of cations of alkali and alkaline earth metals on the anodic oxidation of ferrocyanide in chloride solutions were determined. The influence of temperature on the velocity of the amperometric titration was investigated. The optimal conditions for the precipitation of uranyl ions with potassium ferrocyanide were found to be a 1M solution of KNO_3, pH of 2 to 4, and temperature between 50 and 60°C. In the absence of ferrocyanide excess, the composition of the uranyl ferrocyanide precipitate corresponded to the formula of the double salt. (M.C.G.)

23385 (AEC-tr-4059(p.123-8)) SOLUTIONS OF POLYTHIONATES OF CHROMIUM. I. V. Yanitskii and V. S. Karpus. Translated from Zhur. Neorg. Khim., 2: 2058-61(1957).

Solutions of tetrathionate and pentathionate of chromium were prepared by a reaction of barium polythionates and chromic sulfate. The compounds were analyzed using iodometric methods. Aqueous solutions of these salts were found to have about the same stability as corresponding potassium salts. Attempts to obtain these compounds in crystalline form were unsuccessful. The compounds were highly soluble in alcohol and water. Reservible color changes took place in the compounds on heating. The physicochemical properties of the compounds showed that they dissociate in aqueous solutions as simple salts. (M.C.G.)

23386 (AEC-tr-4059(p.129-36)) THE POLYTHIONATES OF CERTAIN COMPLEX CATIONS OF CHROMIUM. I. V. Yanitskii and V. S. Karpus. Translated from Zhur. Neorg. Khim., 2: 2062-6(1957).

Studies were made of the preparation and solubility of chromium polythionate complexes. Crystalline precipitates of definite composition were not obtained by the introduction of addends often used for complex formation. However when potassium thionates were reacted with chromium complexes, crystalline precipitates were formed. Hexaureachromtetrathionates, chlorpentaminechromtetrathionates, chlorpentaminechrompentathionates, roseotetrathionates, and erythrotetrathoinates were prepared. The last two salts were practically insoluble in water. (M.C.G.)

23387 (AEC-tr-4059(p.137-47)) THE INTERACTION OF BERYLLIUM OXYACETATE WITH ALCOHOLS. A. I. Grigor'ev, A. V. Novoselova, and K. N. Semenenko. Translated from Zhur. Neorg. Khim., 2: 2067-72(1957).

The reactions of beryllium oxyacetates with different alcohols were investigated. The beryllium oxyacetate did not react perceptibly with cold absolute ethanol. With absolute methanol the reaction under the same conditions was observed immediately on mixing the reagents. Boiling absolute ethanol and methanol decomposed the oxyacetate completely in a few minutes. The beryllium semialcoholates were white, finely dispersed powders, insoluble in alcohols and ethers, and soluble in pyridine on heating. The freshly obtained methyl and ethyl beryllium acetates swelled in chloroform and afterwards dissolved. When the chloroform was evaporated, transparent films were formed. Other properties of the acetates were also studied. The reaction of beryllium oxyacetate with n-butanol was carried out. The beryllium butyl acetate was a fine, white, x-ray amorphous powder which could be dissolved by heating in butanol. By prolonged reaction between beryllium oxyacetate with boiling n-butanol, a polymeric product was formed. The thermal decomposition processes of the beryllium polyalcoholates were studied with the aid of the thermogravimetric balance. (M.C.G.)

23388 (AEC-tr-4059(p.210-19)) THE COMPLEX FORMATION OF TETRAVALENT CERIUM WITH ACETATE AND OXALATE IONS. D. I. Ryabchikov and N. S. Vagina. Translated from Zhur. Neorg. Khim., 2: 2109-14(1957).

Methods are given for the separation of tetravalent cerium from rare earths, based on the formation of complexes with acetates and oxalates, are discussed. The complex-formation of Ce(IV) with acetate ions was examined spectrophotometrically. The pH of the solution in the range from 2.0 to 3.5 had no effect on the formation of the cerium complexes. The cerium was easily separated from the lanthanides with a yield of 97 to 98%. The cerium product was of spectrographic purity when purified twice by solvent extraction. (M.C.G.)

23389 (AEC-tr-4059(p.241-52)) THE SOLUBILITY OF FERRIC CHLORIDE AND ITS MELTS NIOBIUM, ALUMINUM AND SODIUM CHLORIDES IN TITANIUM TETRACHLORIDE. I. S. Morozov and D. Ya. Toptygin. Translated from Zhur. Neorg. Khim., 2: 2129-35(1957).

A study was made of the solubility of ferric chloride and its alloys with aluminum, niobium, and sodium chlorides in titanium tetrachloride. $TiCl_4$ dissolved 0.5% $FeCl_3$ at 204°C. Less than 0.01% $FeCl_3$ dissolved at room temperature. The solubility of $FeCl_3$ was increased by the presence of $AlCl_3$ and $NbCl_5$. Tensimetric analyses indicated that no compounds formed between $FeCl_3$ and NaCl and the NaCl salted $FeCl_3$ entirely out from its solutions in $TiCl_4$. (M.C.G.)

23390 (AEC-tr-4059(p.264-75)) FUSIBILITY IN THE TERNARY SYSTEM OF POTASSIUM AND BARIUM NITRATES AND NITRITES. P. I. Protsenko and A. Ya. Malakhova. Translated from Zhur. Neorg. Khim., 2: 2145-53(1957).

An investigation was made of the liquidus area of the reciprocal system of potassium and barium nitrates and nitrites. Four crystallization fields were found in the system: $Ba(NO_3)_2$, solid solutions of KNO_2 and KNO_3, $Ba(NO_2)_2$, and the compound $KNO_2 \cdot Ba(NO_2)_2$. This compound melted without decomposition at 317°C, with 8.51% of the area of crystallization. Compositions of low melting mixtures in the system were established. The area of the liquid of the phase diagram of the system was studied by means of 11 internal cross sections. (M.C.G.)

23391 (AEC-tr-4059(p.276-82)) FUSIBILITY IN A SYSTEM COMPOSED OF SODIUM AND THALLIUM BROMIDES AND CHLORIDES. I. I. Il'yasov, V. M. Fonardzhyan, and A. G. Bergman. Translated from Zhur. Neorg. Khim., 2: 2154-8(1957).

A study was made of the fusibility diagram of the reciprocal system composed of sodium and thallium bromides and chlorides. Two areas of crystallization were formed of two series of solid solutions, which intersected on the joint crystallization curve. Two diagonal and four internal sec-

tions were studied. On the joint crystallization curve of the two series of solid solutions there was a small maximum corresponding to the more stable diagonal TlBr–NaCl which also corresponded to the value of the conventional heat of reaction of the exchange reaction. (M.C.G.)

23392 (AEC-tr-4059(p.283-93)) FUSIBILITY IN THE SYSTEM OF CADMIUM AND LEAD CHLORIDES AND IODIDES. I. I. Il'yasov and A. G. Bergman. Translated from Zhur. Neorg. Khim., 2: 2159-67(1957).

A study was made of fusibility in the reciprocal system of cadmium and lead chlorides and iodides. In the system CdI_2-PbI_2 a continuous series of solid solutions was established with a minimum at 360°C. The anion complex $PbCl_2 \cdot PbI_2$ which melted without decomposition, maintained its stability inside the common system and its crystallization field passed into a triangulating diagonal of a subordinate nature. Twelve internal sections were studied. The system was found to be a semireversible reciprocal system with a subordinate diagonal. (M.C.G.)

23393 (AEC-tr-4059(p.294-9)) FUSIBILITY IN A SYSTEM CONSISTING OF SODIUM AND LEAD BROMIDES AND CHLORIDES. I. I. Il'yasov, G. G.Shchemeleva, and A. G. Bergman. Translated from Zhur. Neorg. Khim., 2: 2168-73(1957).

The fusibility diagram of the ternary reciprocal system consisting of sodium and lead bromides and chlorides was investigated. The conventional heat effect of the exchange reaction was 1.93 kcal/eq towards $Na_2Cl_2-PbBr_2$. The fusibility curve consisted of two crystallization areas which intersected on the cocrystallization curve of two solid solutions. Two diagonal sections and four internal sections were investigated. A displacement of the exchange reaction was observed. (M.C.G.)

23394 (AEC-tr-4059(p.300-5)) FUSIBILITY IN A TERNARY RECIPROCAL SYSTEM COMPOSED OF CADMIUM AND LEAD CHLORIDES AND BROMIDES. I. I. Il'yasov, L. V. Rozhkovskaya, and A. G. Bergman. Translated from Zhur. Neorg. Khim., 2: 2174-7(1957).

The fusibility diagram of a reciprocal system composed of the chlorides and bromides of cadmium and lead was studied. Despite the insignificant conventional heat of reaction of the exchange reaction, equal to 0.36 kcal/eq in the direction of the more stable couple $PbCl_2-CdBr_2$, a slight displacement in the exchange reaction found some reflection on the configuration of the spatial fusibility diagram of the reciprocal system. The investigation was carried out by the visual polythermic method. Three internal sections and two diagonal sections were investigated. (M.C.G.)

23395 (AEC-tr-4059(p.306-11)) FUSIBILITY IN THE SYSTEM OF SODIUM AND POTASSIUM CHLORIDES AND METAVANADATES. M. A. Zakharchenko. Translated from Zhur. Neorg. Khim., 2: 2178-82(1957).

The system of sodium and potassium chlorides and metavanadates was found to belong to the irreversible reciprocal type without complex formation. The liquidus area of the reciprocal system was composed of two major crystallization fields: one covering 20.45% of the area belonged to the solid solutions $(K,Na)VO_3$, the other covering the remaining 79°55% of the area consisted of the solid solutions (K,Na)Cl and their decomposition products. The crystallization area was studied by means of 9 internal cross sections. (M.C.G.)

23396 (AEC-tr-4059(p.342-50)) STUDIES ON MULTICOMPONENT SYSTEMS CONTAINING RARE-EARTH ELEMENTS. N. N. Mironov and A. I. Odnosevtsev. Translated from Zhur. Neorg. Khim., 2: 2202-7(1957).

The precipitation of certain hydroxides by ammonia from multicomponent solutions at different pH values was studied. The activity solubility products of Ti, Fe, Al, Ce, and La hydroxides during precipitation from the system salt–acid–water–ammonium hydroxide was calculated. Results showed that the precipitation zones of the hydroxides are close to each other on fractional precipitation from multicomponent systems. This phenomenon was due in part to the formation of colloids. (M.C.G.)

23397 (AEC-tr-4059(p.351-6)) THE EXTRACTION OF RARE-EARTH ELEMENTS FROM SLURRY. N. N. Mironov and A. I. Odnosevtsev. Translated from Zhur. Neorg. Khim., 2: 2208-11(1957).

An attempt was made to separate the rare earths from apatite slurry after the first neutralization. It was found that they could be separated as hydroxide by the method of basic fractional precipitation with ammonia. It was necessary to first eliminate from the slurry solution phosphates, fluorides, and silicofluorides. (M.C.G.)

23398 (AEC-tr-4060) JOURNAL OF INORGANIC CHEMISTRY. Translation of Zhurnal Neorganicheskoi Khimii, Volume II, No. 10, 1957. 355p. (PST-Cat.-87).

Thirty papers are included which treat many topics in inorganic chemistry. Separate abstracts have been prepared for nine of the papers, while one was previously abstracted in NSA. (D.L.C.)

23399 (AEC-tr-4060(p.37-42)) THE OXYCHLORIDE OF TRIVALENT URANIUM. S. A. Shchukarev and A. I. Efimov. Translated from Zhur. Neorg. Khim., 2: 2304-6 (1957).

UOCl, a dark-red solid, was isolated by distilling UCl_3 in vacuum for 15 min at 1000°C and separating impurities from the residue by settling in water. Its chemical properties were studied. X-ray examination showed UOCl crystals to be of the tetragonal type with lattice constants a = 4.00 A and c = 6.85 A. Comparisons are made between UOCl and the oxymonochlorides of the transuranium elements, Ac, and La. (D.L.C.)

23400 (AEC-tr-4060(p.43-56)) INVESTIGATION OF THE REACTION OF THE FORMATION OF PERURANIC ACID IN SOLUTION. A. M. Gurevich, L. D. Preobrazhenskaya, and E. V. Komarov. Translated from Zhur. Neorg. Khim., 2: 2307-15(1957).

Spectrophotometric and potentiometric studies were made on the reaction of $UO_2(NO_3)_2$ with H_2O_2 in solution. On titration of the reacted solution with NaOH, derivatives corresponding to $NaHU_2O_9$ and $Na_2U_2O_9$ were formed, suggesting the formula of $H_2U_2O_9$ for peruranic acid. The dissociation constants of $H_2U_2O_9$ were estimated to be $K_1 \sim 10^{-7}$, $K_2 \sim 10^{-10}$. The equilibrium constant of formation of $H_2U_2O_9$ was calculated to be 2×10^{-3}. (D.L.C.)

23401 (AEC-tr-4060(p.70-6)) STUDIES ON THE DECOMPOSITION PRODUCTS OF THE SALT $Na_4UO_5 \cdot 9H_2O$. L. P. Polozhenskaya. Translated from Zhur. Neorg. Khim., 2: 2323-6(1957).

Three precipitates were found to form in solutions of Na_4UO_5 under different thermal decomposition conditions. $Na_2U_2O_9 \cdot 6H_2O$ precipitates on heating dilute Na_4UO_5 solutions when the NaOH concentration is less than 2.0 N. $Na_8U_4O_{22} \cdot 3H_2O$ precipitates at 100°C when the U and NaOH concentrations are equal to or greater than 0.1 M and 2.0 N, respectively. Both salts were found to be quite stable. $Na_8U_4O_{22} \cdot 21H_2O$ precipitates from Na_8UO_4 solutions in 2.0 N NaOH when the U concentration is 0.1 to 0.3 M upon heating to 78°C; however, this salt hydrolyzes upon

washing with hot water to form $Na_7HU_4O_{22} \cdot 21H_2O$. The structures of all these salts were determined. (D.L.C.)

23402 (AEC-tr-4060(p.77-87)) SOME CHARACTERISTICS OF THE FORMATION OF CALCIUM ZIRCONATE. A. K. Kuznetsov. Translated from Zhur. Neorg. Khim., 2: 2327-33(1957).

The formation of $CaZrO_3$ in $CaCO_3-ZrO_2$ mixtures was studies. $CaZrO_3$ formation begins at 900°C and reaches a maximum between 980 and 1240°C. The formation takes place on the surface of ZrO_2 crystals. The increase of volume and porosity in the reaction is shown to be due to amorphous $CaZrO_3$ splitting off from the ZrO_2 crystals. (D.L.C.)

23403 (AEC-tr-4060(p.207-15)) X-RAY INVESTIGATION OF THE N BINARY FLUORIDES OF BIVALENT MANGANESE. Yu. P. Simanov, L. P. Batsanova, and L. M. Kovba. Translated from Zhur. Neorg. Khim., 2: 2410-15(1957).

An x-ray study of the compounds $NaMnF_3$, $KMnF_3$, NH_4MnF_3, $RbMnF_3$, and $CsMnF_3$ was carried out which shows that these compounds, except $CsMnF_3$, belong to the perovskite structure type. The lattice parameters were determined, and the refractive indexes of the binary manganese fluorides were measured. (D.L.C.)

23404 (AEC-tr-4060(p.276-97)) THE COMPOSITION AND STABILITY OF SOME ALUMINUM FLUORIDES IN SOLUTION. I. V. Tananaev and A. D. Vinogradova. Translated from Zhur. Neorg. Khim., 2: 276-97(1957).

The solubility of CaF_2 in a large number of aqueous aluminum salt solutions was determined in order to study the interaction between fluoride and aluminum ions. The data support the existence of the AlF_2^+ ion with a dissociation constant of 0.87×10^{-9}. The effects of foreign salts on the $CaF_2-Al(NO_3)_3-H_2O$ system were also studied. The solubility products of aluminum phosphate and oxyquinolate in solutions containing the AlF_2^+ ion were determined to be 3.87×10^{-11} and 1×10^{-19}, respectively. (D.L.C.)

23405 (AEC-tr-4060(p.298-309)) ZIRCONIUM FERROCYANIDES. I. V. Tananaev and E. A. Ionova. Translated from Zhur. Neorg. Khim., 2: 2468-74(1957).

The interaction of ZrOCl with $Na_4[Fe(CN)_6]$ and $K_4[Fe(CN)_6]$ was studied. The compounds $[ZrO(OH)_4][Fe(CN)_6]$ and $ZrO \cdot [ZrO(OH)_2]Fe(CN)_6$ were found to form, but neither normal Zr ferrocyanides nor mixed Zr ferrocyanides could be formed. (D.L.C.)

23406 (AEC-tr-4060(p.327-34)) SOLUBILITY OF LANTHANUM PHOSPHATE IN AQUEOUS SOLUTIONS OF PHOSPHORIC ACID AT 80°. N. A. Vasilenko and M. L. Chepelevetskii. Translated from Zhur. Neorg. Khim., 2: 2486-9(1957).

The solubility of $LaPO_4 \cdot nH_2O$ in aqueous solutions of H_3PO_4 was measured at 80°C for P_2O_5 concentrations of 11 to 42%. A method was devised for determining La in the presence of phosphates. (D.L.C.)

23407 (AERE-Trans-862) THE KINETICS OF THE REACTION OF CARBON WITH CARBON DIOXIDE GAS AND WATER VAPOUR. P. N. Galushko and B. V. Kantorovich. Translated by J. B. Sykes (Atomic Energy Research Establishment) from Trudy Inst. Goryuchikh Iskopaemykh, Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, 11: 39-45(1959). 11p.

It was found that the change in volume of the reaction products affects the apparent order of the reaction $C + CO_2 \rightleftharpoons 2CO$. At temperatures from 800 to 1040° the rate of reduction of carbon dioxide by carbon was proportional to the concentration of CO_2. Thus the reaction is first-order. In the diffusion region the rate of the reaction was independent of pressure. However, in the kinetic region the rate increased as the temperature increased. The rate of interaction of water vapor with carbon was found to be of an order which varies from first to zero, at temperatures from 800 to 1050°. The rate of the reaction was first-order at water vapor concentrations up to 5%, but zero-order beyond this value. (M.C.G.)

23408 (CEA-tr-R-530) SYNTHESE DES COMPOSES ORGANIQUES MARQUES ET LEUR ANALYSE RADIOCHIMIQUE. (Synthesis of Labeled Organic Compounds and their Radiochemical Analysis). I. A. Korchunov and N. F. Novotorov. Translated into French from a Russian book, Moscow, 1958 (p.341-7). 13p.

Organic compounds labeled with C^{14} in various locations were prepared and studied radiochemically. The syntheses used $C^{14}O_2$ with Grignard reagents and LiR-type compounds, and the products included alcohols, complex ethers of carboxylic acids, ketones, alkanes, and alkenes. The activities of the products and by-products were measured by introduction of the organic vapor or CO_2 from combustion into a counter tube. The error does not exceed ±1% for this method. The high counting efficiency and low background permit measurement of very low specific activities. The isotope dilution effect which occurs during the measurements makes it possible to determine the number of C atoms in the organic molecule and to determine the purity of the labeled compound. (T.R.H.)

23409 (NP-tr-619) THE ROLE OF THE ADIABATIC EXPONENT IN CHEMICALLY VARIABLE GAS MIXTURES. Irene Sanger-Bred't. Translated from pages 35-66, Vol. VI, "Der Adiabatenexponent bei Chemisch Veranderlichen Gasgemischen". 1955. 33p.

The concept of the "adiabatic exponent" or the specific heat ratio which denotes the ratio of the specific heats at constant pressure and volume is discussed. The limiting assumptions used were conditions of constant specific heats of the individual gases and constant partial pressure ratios of the gas mixtures. An attempt was made to give a systematic and separate treatment of each of the two limiting auxiliary conditions and then to construct generalized equations which are valid even on elimination of one or both restrictions and representing the classical aerodynamic laws as specific cases. Adiabatic equations were developed, even in the case of chemically variable flows. The applicability of classical specific heat ratios in cases of certain flows not in equilibrium is explained. An example of a gas mixture with the numerical values of hydrogen, variable in accordance with the reaction scheme $X_2 \rightleftharpoons 2X$ is presented. (M.C.G.)

23410 (UCRL-Trans-679) THE KINETICS OF THE SAPONIFICATION OF DIALKYLPHOSPHITES. I. SAPONIFICATION WITH HYDROGEN- AND HYDROXYL-IONS. Paul Nylén. Translated for Univ. of California. Lawrence Radiation Lab. from Svensk Kem. Tidskr., 49: No. 2, 29-52(Feb. 1937). 53p.

Hydrolysis of dialkylphosphite to monoalkylphosphite was studied for dimethyl-, diethyl-, dipropyl-, diisopropyl-, and dibutyl-phosphites under a variety of conditions, including both acidic and alkaline aqueous solutions. Reaction rate constants were determined. The effects of pH and salts on the hydrolysis were studied. The results are compared with similar data for esters of other organic acids. (D.L.C.)

23411 AN ISOTOPIC EXCHANGE STUDY OF THE U(IV)–U(V)–U(VI) EQUILIBRIUM IN AQUEOUS PERCHLORATE

SOLUTIONS. B. J. Masters and Larry L. Schwartz (Los Alamos Scientific Lab., N. Mex.). J. Am. Chem. Soc., 83: 2620-4(June 20, 1961).

Measurements of U(IV)-U*(VI) exchange were employed in an investigation of the reaction U(IV) + U(VI) ⇌ 2U(V) under conditions of chemical equilibrium in perchlorate media of ionic strength 2.0. A successful separation of the exchange path from the competitive exchange reaction was found possible at U(IV) concentrations below 0.01 M and temperatures of 25° and higher. The equilibrium reaction was found to obey the rate law $R_{xg} = k[U^{4+}][UO_2^{2+}][H^+]^{3-}$, with a rate constant of $k = 2.13 \times 10^{-1}$ M^3 $sec.^{-1}$ being observed at 25°. The thermodynamic quantities of activation were found to be $\Delta H^* = 37.5$ kcal/mole and $\Delta S^* = 36$ e.u. The results are consistent with polarographic measurements of the U(IV)-U(V)-U(VI) equilibrium and of the U(V) disproportionation reaction. The U(IV)-U*(VI) exchange rate was found to be strongly accelerated by irradiation. (auth)

23412 THE SECONDARY α-DEUTERIUM ISOTOPE EFFECT: THE MECHANISM OF THE THERMAL DECOMPOSITION OF AZO-BIS-α-PHENYLETHANE. Stanley Seltzer (Brookhaven National Lab., Upton, N. Y.). J. Am. Chem. Soc., 83: 2625-9(June 20, 1961).

The secondary α-deuterium isotope effect in the free radical cleavage of azo-bis-α-phenylethane-α,α′-d_2 in ethylbenzene as solvent, was found to be 1.27 ± 0.03 at 105°C. A large body of data on secondary α-deuterium isotope effects indicates that an average value of 1.12, at this temperature, corresponds to a system where only one bond is being broken in the slow step. Since the measured effect is about twice as large, it appears that both carbon-nitrogen bonds are being broken simultaneously in the transition state. The method represents a new way of differentiating between a simultaneous and stepwise two-bound rupture. Comparison of the deuterium content in the solid product, meso-2,3-diphenylbutane-2,3-d_2, with that of the starting azo compound, indicates that hydrogen abstraction by the intermediate α-phenylethyl radical from ethylbenzene, does not occur. (auth)

23413 DEUTERIUM ISOTOPE EFFECTS DURING ACID CATALYZED ANOMERIZATION AND C1 ACETOXY EXCHANGE REACTIONS OF ACETYLATED d-ALDOPYRANOSES. William A. Bonner (Stanford Univ., Calif.). J. Am. Chem. Soc., 83: 2661-3(June 20, 1961).

C1 Inversion and C1 acetoxy exchange rates were measured for penta-O-acetyl-D-glucose and tetra-O-acetyl-D-xylose anomers both in systems containing $AcOH-Ac_2O-H_2SO_4$ and containing $AcOD-Ac_2O-D_2SO_4$, in order to investigate the deuterium isotope effect in the anomerization reaction. In deuteriated anomerization environments, the rates of both inversion and C1 acetoxy exchange were approximately 1.7 times greater than those observed in environments lacking deuterium. A qualitative explanation for these observations is given, and the data are discussed with reference to an S_N1 mechanism for the anomerization reaction. (auth)

23414 B^{11} N.m.r. CHEMICAL SHIFTS. II. AMINE-BORATE ESTER COMPLEXES, ALKOXYDIFLUOROBORANE TRIMERS AND TETRAHALOBORATE IONS. Herbert Landesman and Robert E. Williams (National Engineering Science Co., Pasadena, Calif.). J. Am. Chem. Soc., 83: 2663-6(June 20, 1961).

The B^{11} nmr spectra of BF_2Cl and $BClF_2$ were obtained, but no $B^{11}-F^{19}$ spin coupling could be observed. Some amine addition compounds of triethyl and triallyl borates were prepared and the B^{11} chemical shifts are found to be dependent on reactant concentrations. Thus borate-amine exchange is taking place. Evidence that the compounds produced from the reaction of one mole of various borate esters and two moles of boron trifluoride are alkoxydifluoroborane cyclic trimers rather than the previously suggested coördination complexes is presented. Chemical shifts for tetrahalo and tetrapseudohalo borate ions prepared in nitrobenzene are presented. (auth)

23415 ANOMALOUS HYDROGEN–DEUTERIUM DISTRIBUTION IN STIBINE PREPARED FROM ANTIMONY(III) AND BOROHYDRIDE IN HEAVY WATER. Thomas Freund (Convair Scientific Research Lab., San Diego, Calif.). J. Am. Chem. Soc., 83: 2779(June 20, 1961).

Stibine was prepared by slowly dropping a heavy water solution 2.5F NaOD, 0.5F $KSbO(C_4H_4O_6)$, and 0.4F KBH_4 into a heavy water solution 2F in D_2SO_4, while bubbling N_2 through at 11 cm total pressure. The total exchangeable hydrogen was 97% D. The preparation yielded SbH_3 to SbD_3 in a ratio of about 15:1 with no partially deuterated stibine detectable. Mass spectrographic analysis of stibine showed a broad peak in the 120 to 130 region, no oxygen, a little water with H_2O greatest and D_2O least, and small amounts of H_2, HD, and D_2 with an H to D ratio of about 15. The only deuterated product found was SbD_3. (P.C.H.)

23416 ELECTRONEGATIVITY VALUES FROM THERMOCHEMICAL DATA. A. L. Allred (Northwestern Univ., Evanston, Ill.). J. Inorg. & Nuclear Chem., 17: 215-21 (June 1961). (In English)

The electronegativities of 69 elements were calculated from the most recent thermochemical data. The mean deviation of the calculated electronegativity difference, $0.208\sqrt{\Delta}$, from the difference of the average electronegativities is 0.046 units. The trends of electronegativity values within the periodic system are summarized. The transition metal contraction, the lanthanide contraction, and crystal field stabilization contribute to the relative values of electronegativity. (auth)

23417 THE ELECTRODEPOSITION OF INSOLUBLE HYDROXIDES. AN EXPERIMENTAL INVESTIGATION. P. G. Hansen (Research Establishment, Riso, Denmark). J. Inorg. & Nuclear Chem., 17: 232-9(June 1961). (In English)

The cathodic deposition of radioactive rare earths was studied. The experiments establish the existence of a critical current density I_{min}, below which no deposition takes place. The dependence of I_{min} on the acid concentration and the stirring rate was examined for HNO_3 solutions. The results are in agreement with calculations based on the diffusion layer concept. The addition of inert salts such as $Ba(NO_3)_2$ or KNO_3 causes a substantial decrease in the deposition rate. Most experiments were performed with platinum cathodes, but Ag and Au are equally applicable. Alcohol in the solution improves the source quality. (auth)

23418 ON THE RESOLVABILITY OF THE TRIS (CATECHOLATO) ALUMINATE ION. K. D. Maguire and M. M. Jones (Vanderbilt Univ., Nashville). J. Inorg. & Nuclear Chem., 17: 240-3(June 1961). (In English)

Repeated attempts to resolve the tris(catecholato) aluminate ion using reported procedures were uniformly unsuccessful. All instances where rotations were observed could be attributed to residual resolving agent. An examination of the ligand exchange with 4-chloracatechol shows that such exchange is rapid at a pH of 8.6 at 25°C. However, the residual optical activity observed with solutions in which the presumably resolved complex was present showed no noticeable change over a period of days. (auth)

23419 THE INTERACTION OF OSMIUM TETROXIDE AND AMMONIA. G. W. Watt and E. M. Potrafke (Univ. of Texas, Austin). J. Inorg. & Nuclear Chem., 17: 248-53 (June 1961). (In English)

The reaction between OsO_4 and either gaseous or liquid ammonia involves reduction to Os^{6+} in a single osmium-containing product, $Os_3N_7O_3H_{21}$; the other products are N_2 and H_2O. Numerous properties of the osmium(VI) compound are described and a trinuclear structure that involves bridging through amido groups is suggested. (auth)

23420 AMINE DERIVATIVES OF VANADIUM AND NIOBIUM PENTAFLUORIDES. R. G. Cavell and H. C. Clark (Univ. of British Columbia, Vancouver). J. Inorg. & Nuclear Chem., 17: 257-64(June 1961). (In English)

The reactions of vanadium pentafluoride with ammonia, pyridine, and ethylenediamine produce amminotetrafluorovanadium(VI), pyridinetetrafluorovanadium(VI) and tris (ethylenediamine)tetrafluorovanadium(IV) respectively. Niobium pentafluoride reacts with ammonia and ethylenediamine to give diamminopentafluoroniobium(V) and a product of composition $NbF_5(en)_{1.6}$. The infrared spectra of these new compounds are discussed and reasons for the production of these compounds are considered in terms of maximum co-ordination state and fluorine-bridge bonding. (auth)

23421 THE THERMAL DECOMPOSITION OF THORIUM (IV), URANIUM(IV), AND THE RARE-EARTH METAL(III) OXALATE HYDRATES. DIFFERENTIAL THERMAL ANALYSIS AND WEIGHT-LOSS STUDIES. W. W. Wendlandt, T. D. George, and G. R. Horton (Texas Technological Coll., Lubbock). J. Inorg. & Nuclear Chem., 17: 273-80 (June 1961). (In English)

Differential thermal analysis (DTA) curves are presented for Th, Sc, U^{4+}, and the rare-earth metal oxalate hydrates. For all the metal oxalate hydrates, endothermic and exothermic peaks are present in the curves which are the result of dehydration, decomposition, and oxidation reactions. The DTA curves for Th and La oxalates differ from those previously reported. A weight-loss curve is presented for the thermal decomposition of the 6- and 2-hydrates of U^{4+} oxalate. (auth)

23422 THE THERMAL DECOMPOSITION OF CERIUM (III) NITRATE HYDRATE. F. Vratny, S. Kern, and F. Gugliotta (Purdue Univ., Lafayette, Ind.). J. Inorg. & Nuclear Chem., 17: 281-5(June 1961). (In English)

The thermal decomposition of cerium(III) nitrate hydrate was measured in the temperature range 190° <T <300°C. Employing information obtained from the infrared spectra it was found that the decomposition proceeds via the loss of nitrate from the cerium(III) nitrate sample. The composition of the final intermediate decomposition products was measured and is discussed. (auth)

23423 THE RATES OF THE ELECTRON EXCHANGE REACTION BETWEEN U(IV) AND U(VI) IONS IN WATER, ETHYLENE GLYCOL AND WATER–ETHYLENE GLYCOL SOLVENTS. S. L. Melton, J. O. Wear, and E. S. Amis (Univ. of Arkansas, Fayetteville). J. Inorg. & Nuclear Chem., 17: 317-24(June 1961). (In English)

The rate of the electron exchange reaction between U^{4+} and U^{6+} ions was studied at 25°C in water, glycol and water–glycol solvents, and at various concentrations of U^{4+}, U^{6+}, and HCl. The order of the reaction with respect to each of these substances was found to depend on the composition of the solvent. The rates of the reaction in the water–glycol were slower by factors of 2 to about 4 orders of magnitude than were the rates of the reaction in the water–ethanol and water–acetone system. The slowing down of the reaction in water–ethylene glycol as compared to water–ethanol and water–acetone is attributed to the replacement of water in the inner solvation layer of the uranyl ion by the ethylene glycol. (auth)

23424 THE RATES OF THE ELECTRON EXCHANGE REACTIONS BETWEEN U(IV) AND U(VI) IONS IN WATER AND WATER–ACETONE SOLVENTS. S. L. Melton, A. Indelli, and E. S. Amis (Univ. of Arkansas, Fayetteville). J. Inorg. & Nuclear Chem., 17: 325-33(June 1961). (In English)

The rate of the electron exchange reaction between U^{4+} and U^{6+} ions was studied at 25° in water and water–acetone mixtures containing 30, 60, and 90% by volume acetone, and at various concentrations of U^{4+}, U^{6+}, and HCl. The order of the reaction with respect to each of these solutes was found to depend strongly upon the composition of the solvent. A departure in the trend of the rate dependence on hydrogen ion concentration was found for more dilute acid concentrations in 60% acetone. Comparisons of the kinetics of the reaction in the two systems are made. Mechanistic and kinetic discussions are included. (auth)

23425 COMPLEXES OF DIBUTYL PHOSPHORIC ACID. W. H. Baldwin and C. E. Higgins (Oak Ridge National Lab., Tenn.). J. Inorg. & Nuclear Chem., 17: 334-6 (June 1961). (In English)

Highly associated complexes are formed between dibutyl phosphoric acid and the cations: Cu^{2+}, UO_2^{2+}, Fe^{3+}, Y^{3+}, La^{3+}, Al^{3+}, Th^{4+}. Pu^{32}-labeled dibutyl phosphoric acid was used to assist in the analysis of the compounds. Metathesis of the solid Th^{4+} complex with aqueous NaOH was complete, suggesting a practical method for removing the complexes from solvents and equipment. (auth)

23426 STUDIES ON MONO- AND DI-n-BUTYLPHOSPHORIC ACIDS. III. THE EXTRACTION OF ZIRCONIUM FROM NITRATE SOLUTIONS BY DI-n-BUTYLPHOSPHORIC ACID. C. J. Hardy, D. Scargill, (A.E.R.E., Harwell: Berks, Eng.). J. Inorg. & Nuclear Chem., 17: 337-49(June 1961). (In English)

The extraction of ~10^{-6} M zirconium from nitrate solution by di-n-butylphosphoric acid (HDBP) was studied as a function of the concentrations of HDBP, HNO_3, NO_3^-, and H^+. The distribution coefficient for Zr is proportional to the second power of the final $[HDBP]_{org}$ over the range 10^{-5} to 10^{-3} M HDBP, and to the first power of $[NO_3^-]$, and is independent of $[H^+]$ at a constant ionic strength of 2. The mechanism of extraction of Zr by HDBP, and of other metals by di-alkylphosphoric acids, over a wide range of conditions, is discussed and compared with the mechanism of extraction of Zr by tributyl phosphate (TBP) and by thenoyltrifluoroacetone (HTTA). The preparation and infrared spectra of Zr bis-dibutylphosphate dinitrate are described. (auth)

23427 GROUP SEPARATION OF THE ACTINIDES FROM THE LANTHANIDES BY ANION EXCHANGE. E. K. Hulet, R. G. Gutmacher, and M. S. Coops (Univ. of California, Livermore). J. Inorg. & Nuclear Chem., 17: 350-60(June 1961). (In English)

The separation of the lanthanides from the tripositive actinides was accomplished by column elution with 10M LiCl solutions or stronger using a moderately cross-linked, strongly basic, anion exchange resin at an elevated temperature. Fractionation of the actinide ions into the groups Pu, Am–Cm, Bk, and Cf–Es can be obtained during the same column elution. The distribution coefficient D_v of representative actinides and lanthanides was investigated as a function of LiCl and H^+ concentration, temperature,

and cross-linkage of the resin, using the column elution technique. In addition, adsorption kinetics were investigated by measurement of Am elution peak half-widths over a range of flow-rates at 25 and 87°C with 2, 8, and 10% DVB resin of several particle sizes. The formation of anionic complexes is markedly influenced by the LiCl and H^+ concentrations. D_v for La, Lu, Am, and Cf uniformly decreased by nearly one-forth when the H^+ concentration was increased from 0.1 to 1.0M, while maintaining the chloride ion concentration constant at 10.15M. Except for deviations observed in the elution order of Gd and Ho and their corresponding actinide homologs, Cm and Es, the elution sequence proceeded in order of increasing atomic number, La being the least strongly adsorbed. Under acceptable operating conditions the ratio $D_v(Am)/D_v(La) = 19$. (auth)

23428 EXTRACTION AND ION EXCHANGE INVESTIGATION OF URANIUM(VI) CHELATES. J. Stary and J. Prasilova (Faculty of Technical and Nuclear Physics, Prague). J. Inorg. & Nuclear Chem., 17: 361-5(June 1961). (In English)

The composition and the stability constants of uranium (VI) chelates with nitrilotriacetic acid, ethylenediaminetetracetic acid, and 1,2-diaminecyclohexanetetraacetic acid were determined by means of extraction and ion exchange methods. (auth)

23429 THE ADSORPTION OF CALCIUM, STRONTIUM AND THALLIUM IONS FROM MOLTEN SALTS BY SILICA AND ALUMINA. T. L. Roach and D. M. Himmelblau (Univ. of Texas, Austin). J. Inorg. & Nuclear Chem., 17: 373-81 (June 1961). (In English)

The adsorption of Ca, Sr, and Tl ions by silica and alumina from a $ZnCl_2$–KCl eutectic was investigated. Adsorption rates, adsorption isotherms, and adsorption column data were determined. No adsorption for any of the cations could be obtained on the silica. Ca and Sr were found to be adsorbed by alumina, while the Tl was not adsorbed. The rate of adsorption of Sr on alumina was twice as fast as that of Ca. The Ca isotherm at 250°C was of the general form fitted by the Freundich or Langmuir equations, while the Sr isotherm was very anomalous. The data obtained from the adsorption column indicated that it might be feasible to separate rather large amounts of Ca and Sr from molten salts by adsorption on alumina. However, no effective way was found to elute the cations from the alumina packing. (auth)

23430 ISOTOPIC EXCHANGE OF PLATINUM BETWEEN $[Pt(en)_2]$ AND TRANS-$[Pt(en)_2Cl_2]$. L. T. Cox, S. B. Collins, and D. S. Martin, Jr. (Ames Lab., Ames, Iowa). J. Inorg. & Nuclear Chem., 17: 383-5(June 1961). (IS-209). (In English)

The exchange rates for Pt between the complex ions $[Pt(en)_2]^{2+}$ and $[Pt(en)_2Cl_2]^{2+}$ indicated with a Pt^{195} tracer are evaluated. If the rate of exchange is given by $R = K[Pt(en)_2^{2+}][Pt(en)_2Cl_2^{2+}][Cl^-]$, the rate constant, K, is related to the half-time of an exchange experiment, $\tau_{1/2}$, by the expression $K = \ln 2/([Pt(en)_2^{2+}] + [Pt(en)_2Cl_2^{2+}])[Cl^-]\tau_{1/2}$. Indicated values of K are given. (P.C.H.)

23431 ISOTOPIC CHLORINE EXCHANGE BETWEEN TRIMETHYLCHLOROSILANE AND HYDROGEN CHLORIDE. Rolfe H. Herber (Rutgers Univ., New Brunswick, N. J. and Shih-Chen Chang. J. Inorg. & Nuclear Chem., 17: 385-7 (June 1961). (In English)

In order to establish the dependence of the chlorine exchange between HCl and trimethylchlorosilane on the HCl concentration, experiments were carried out in reaction vessels of constant volume (39.16 cm^3) and with a constant quantity of liquid silane. Assuming a linear relationship between the HCl concentration in the liquid phase and the total HCl pressure, the order of the reaction was established. Despite considerable effort the scatter of the data was severe. (P.C.H.)

23432 REACTION OF OSMIUM TETROXIDE WITH IODIDE IONS. E. Fenn (University Coll., London), R. S. Nyholm, P. G. Owston, and A. Turco. J. Inorg. & Nuclear Chem., 17: 387-90(June 1961). (In English)

The reduction of osmium tetroxide by iodide ions in the presence of HCl yields a variety of products. A flow sheet of the products obtained is given. Spectra were found useful in establishing the nature of the mixed crystals. It is concluded that the mixed crystals contain K_2OsCl_6 and a hitherto unknown iodo-chloro complex of the type $K_2OsCl_xI_{6-x}$ where x is 3 or 4. (P.C.H.)

23433 TWO ELECTRICALLY-OPERATED TITRANT VALVES. John T. Stock and M. A. Fill (Univ. of Connecticut, Storrs). Lab. Practice, 302-4(May 1961).

The electrically-operated burette or titrant valves in which compression of a flexible tube controls the flow are described. Both are designed to operate on 4 to 6 volt d-c supply and have built-in controls for wide adjustment of the rate of titrant delivery. In addition, the response of the second of the valves is designed quite sensitive to the operating voltage in order that remote control of the flow rate is possible. (N.W.R.)

23434 INFRARED SPECTRA OF SOME ORGANOPHOSPHORUS EXTRACTANTS. C. A. Horton and J. C. White (Oak Ridge National Lab., Tenn.). Talanta, 7: 215-31(Feb. 1961). (In English)

The infrared spectra of a group of organophosphorus compounds useful for extraction of metals from acidic solutions are presented and discussed. The spectra of a few organophosphorus degradation products or probable impurities are also included. Many of the organic groups responsible for some of the absorption bands are identified. (auth)

23435 COMPLEX COMPOUNDS OF AQUA-CARBOÖXALATO-URANATES. I. I. Chernyaev, V. A. Golovnya, and R. N. Shchelokov (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 549-56(Mar. 1961). (In Russian)

Potentiometric titrations of uranyl oxalates by alkali metal and ammonium carbonate solutions indicate step-like reactions forming mixed oxalatocarbonate compounds. Such complex compounds were found and ammonium, sodium, potassium, and barium derivatives were synthesized: $(NH_4)_2[UO_2(CO_3)(C_2O_4)(H_2O)_2]$; $Na_2[UO_2(CO_3)(C_2O_4)(H_2O)_2]\cdot H_2O$; $K_2[UO_2(CO_3)(C_2O_4)(H_2O)_2]$; and $Ba[UO_2(CO_3)(C_2O_4)(H_2O)_2]\cdot 2H_2O$. In aqueous solution compounds, except for the barium compound, are tri-ionic electrolytes. The genetic bond between uranyl carbonate, oxlate, and sulfate compounds, is studied. (R.V.J.)

23436 URANIUM(IV) SULFATE COMPOUNDS. V. A. Golovnya and G. T. Bolotova. Zhur. Neorg. Khim., 6: 566-74(Mar. 1961). (In Russian)

Reduction of U(VI) to U(IV) was achieved with thiourea dioxide, and it is shown that thiourea dioxide acts as an addend instead of a reducing agent. $UO_2SO_4(NH_2)_2CSO_2\cdot H_2O$ was separated and various sulfate complexes of uranium (IV) were synthesized: $K_4[U(SO_4)_4]\cdot 2H_2O$, $Rb_4[U(SO_4)_4]\cdot 2H_2O$, $Na_4[U(SO_4)_4]\cdot 6H_2O$, $(NH_4)_4[U(SO_4)_4]\cdot 3H_2O$, $Na_6[U(SO_4)_7\cdot 2H_2O]\cdot 2H_2O$, $Cs_2[U(SO_4)_3\cdot 2H_2O]$, $(NH_4)_6[U(SO_4)_5]\cdot 4H_2O$. Thiourea and acetamide uranium compounds were

also synthesized: $[U(SO_4)_2 4CO(NH_2)_2]$, $[U(SO_4)_2 4CO(NH_2)] \cdot 4H_2O$, and $[U(SO_4)_2 4CH_3NH_2CO]$. (R.V.J.)

23437 PROCESS FOR THE PRODUCTION OF GRAFT COPOLYMERS. (to Societe des Usines Chimiques Rhone-Poulenc). British Patent 872,132. July 5, 1961.

A process for the production of articles of grafted polyvinyl alcohol is described. The process consists of impregnating a shaped article of polyvinyl alcohol with an aqueous solution of a radical-forming catalyst and subjecting the article under radical-forming conditions to the action of an ethylenically unsaturated monomer in the liquid or vapor phase. The catalyst medium is a mixture of water and glycol and the catalyst is a water-soluble per-salt or a redox system. Grafting is carried out at upwards of 40°C, wherein a hydrophobic monomer is used for grafting and grafting is continued until the article is completely insoluble in water. The monomer is acrylonitrile, vinyl chloride, methyl methacrylate, or vinyl acetate. (N.W.R.)

23438 IMPROVEMENTS RELATING TO THE PRODUCTION OF GRAFT COPOLYMERS. (to E. I. du Pont de Nemours and Co.). British Patent 872,515. July 12, 1961.

A process is given for preparing a graft copolymer of a normally solid synthetic linear polyamide. The process consists of contacting the polyamide with a fluid comprising the modifier of the formula $CX_2 = CX_2$ wherein X is hydrogen, an organic radical, or an inorganic atom or radical with the other X being other than hydrogen. The contact takes place in the absence of any polymerization catalyst at a temperature of at least 25°C but below the melting temperature of the polyamide and for a time sufficient for a grafting to take place. The grafting is effected by heating or, in some cases, by extended contact time at room temperature. When grafting takes place, the double bond of the modifier breaks and the modifier adds to the polyamide chain as a side group. The polyamide may be poly(hexamethylene adipamide) or polycaproamide. The modifiers may be styrene, 2,5-dichlorostyrene, vinylidene chloride, or the methyl ether of dodeca-ethylene glycol alpha-methacrylate. (N.W.R.)

Analytical Procedures

23439 (AERE-AM-69) THE DETERMINATION OF RADIOCERIUM. G. J. Hunter and M. Perkins (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Mar. 1961. 16p.

Radiocerium with added cerium and lanthanum carriers was separated from other fission products by a fluoride precipitation. After dissolving the precipitate the cerium was oxidized with bromate and precipitated twice as ceric iodate. After reduction of the cerium, a zirconium iodate scavenge was carried out and the cerium was precipitated as the hydroxide and finally as the oxalate, which was ignited to ceric oxide and counted. The method is applicable to solutions of fission products in nitric or hydrochloric acid, and is written with particular reference to the determination of Ce^{141} and Ce^{144}. The coefficient of variation should not exceed 5% when counting statistics permit. (auth)

23440 (AERE-AM-80) THE DETERMINATION OF RADIOSTRONTIUM IN LIQUID MILK. G. S. Spicer (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). June 1961. 11p.

Strontium carrier is added to the liquid milk and the protein precipitated by the addition of HCl. The insoluble matter is removed by filtration, and the Ca and Sr precipitated from the filtrate as oxalates. The strontium is then separated by conventional radiochemical procedures. (auth)

23441 (AERE-AM-81) THE DETERMINATION OF URANIUM IN LOW GRADE ORES BY AN X-RAY SPECTROGRAPHIC TECHNIQUE. J. Watling (United Kingdom Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Mar. 1961. 7p.

Molybdenum, as the internal standard, is incorporated into the ore sample by grinding. The intensity of the U and Mo fluorescent lines is measured using the Philips x-ray spectrograph. (auth)

23442 (AERE-R-3666) THE X-RAY FLUORESCENCE SPECTROGRAPHIC DETERMINATION OF URANIUM. H. I. Shalgosky and J. Watling (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Feb. 1961. 7p.

The sample preparation and instrumental conditions for the determination of uranium in low grade ore powders by fluorescent x-ray spectrography are reported. (auth)

23443 (CEA-1756) METHODE DE REDUCTION DES ERREURS DE MEMOIRE DANS LES ANALYSES ISOTOPIQUES DE L'HEXAFLUORURE D'URANIUM PAR SPECTROMETRIE DE MASSE. (A Method for Reducing Memory Errors in the Isotopic Analyses of Uranium Hexafluoride by Mass Spectrometry). Roger Bir (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 37p.

Presented at Congress of American Society for Testing Materials Committee E-14, Atlantic City, June 26–July 1, 1960.

One of the most serious causes of systematic error in isotopic analyses of uranium from UF_6 is the tendency of this material to become fixed in various ways in the mass spectrometer. As a result the value indicated by the instrument is influenced by the isotopic composition of the substances previously analyzed. The resulting error is called a memory error. Making use of an elementary mathematical theory, the various methods used to reduce memory errors are analyzed and compared. A new method is then suggested which reduces the memory errors to an extent where they become negligible over a wide range of U^{235} concentration. The method is given in full, together with examples of its application. (auth)

23444 (CEA-1927) ANALYSE SPECTROGRAPHIQUE DES IMPURETES MINERALES DANS L'EAU LOURDE. (The Spectrographic Analysis of Inorganic Impurities in Heavy Water). J. Artaud, J. Normand, and R. Vie (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 19p.

Inorganic impurities in heavy water are determined by two spectrographic methods. First the copper-spark method is described which is sensitive and directly applicable, and is particularly useful because of the absence of a support. Secondly the graphite impregnation method is given; this is used when the first method is not applicable (determination of copper) and for the alkali metals. For the usual elements, the sensitivity of the copper spark method is of the order of 0.1 μg/ml whereas for the graphite impregnation method the sensitivity is only 0.3 μg/ml. (auth)

23445 (CEA-1928) DOSAGE SPECTROGRAPHIQUE DU BERYLLIUM DANS L'ATMOSPHERE. (Spectrographic Measurement of Beryllium in the Atmosphere). J. Artaud,

J. Cittanova, C. Crehange, and S. Frequelin (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay) and G. Baudin (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Grenoble). 1961. 11p.

A method for the spectrographic determination of beryllium on filters is described which is valid for amounts varying between 0.01 and 30 μg of beryllium and which is independent of the nature of the beryllium compound involved. This is a flux method (graphite–lithium carbonate mixture), the excitation being by a direct current arc. (auth)

23446 (GEAP-3574) ANALYTICAL METHODS FOR CONSUMERS RESEARCH AND DEVELOPMENT PHYSICS. M. L. Couchman and C. L. Miller (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Nov. 1, 1960. 14p.

An analytical method presently being used in physics studies in support of the consumer's research and development program is described. The method involves application of several computer codes to calculate effective three-group cross sections and to perform the cell or core diffusion calculation required to obtain reactivity and power distribution. Epithermally, a 54-group scheme was used in which corrections for fast fission and absorptions in U^{238} were applied separately. In the thermal group, the Wilkins heavy gas model was used, combined with flux depression factors from a transport approximation calculation. The methods were applied to 6 of the Savannah uniform critical assemblies and one of the non-uniform assemblies. In the case of the uniform criticals, the discrepancy between measured and calculated reactivity was always less than 1% K_{eff}. Three different water-to-fuel ratios were included in the study. In the case of the single non-uniform critical, the calculated K_{eff} was only 0.5% higher than the measured value. (auth)

23447 (HW-SA-2206) THE DETERMINATION OF GOLD IN BLOOD WITHOUT CHEMICAL SEPARATION BY THE USE OF NEUTRON ACTIVATION AND SCINTILLATION SPECTROMETRY. R. N. Diebel and A. B. Garrett (Ohio State Univ., Columbus and General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 14p.

Neutron activation studies of the blood are discussed. The quantities of various activities which would be produced in a sample of whole blood were computed. Tables and graphs showing the composition of a typical sample of whole blood along with the activities which would be induced by a two-hour irradiation in a neutron flux of 10^{13}, the gamma rays associated with the elements present in the blood, an example of gold analysis, the spectra of blood samples from an individual never treated with gold salt injections, and the results for the gold content of blood from patients who received gold therapy for rheumatoid arthritis are given. The data presented indicate that gold is readily determined in the blood only when the level is greater than 10 times that found in a normal individual. (M.C.G.)

23448 (HW-SA-2209) FUSED SALT SPECTROPHOTOMETRY. [PART III]. URANIUM IV IN CHLORIDE MELTS. John R. Morrey (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 1961. Contract AT(45-1)-1350. 14p.

Absorption spectra of UCl_4 in fused NaCl, KCl, CsCl, KCl–$AlCl_3$, CsCl–$AlCl_3$, and $ZnCl_2$ were obtained over the range of 300 to 2600 mμ at temperatures up to 850°C. Results indicated that hexachlorouranate (UCl_6^{2-}) exists in equilibrium with at least one other species in all solvents but $ZnCl_2$. The order of stability of UCl_6^{2-} in the various solvents was CsCl–$AlCl_3$ = KCl–$AlCl_3$ > CsCl > KCl > NaCl > $ZnCl_2$. Theoretical implications from this series are discussed. The identity of the other species was not established. However, evidence indicated that it has less ligands than UCl_6^{2-} and probably is tetrachlorouranate (IV). The spectrum of U(IV) in CsCl–$AlCl_3$ and KCl–$AlCl_3$ varied with the MCl/$AlCl_3$ ratio, changing markedly at the stoichiometric ratio ($MAlCl_4$). Theoretical implications from this phenomenon as well as temperature effects are also discussed. (M.C.G.)

23449 (NP-9532) RADIOMETRIC TRACE ANALYSIS OF LEAD (thesis). Pieter Cornelis Van Erkelens (Utrecht, Hijksuniversiteit). 1960. 111p.

Techniques in trace analysis, particularly in the determination of traces of Pb, were investigated. Analysis with radioactive reagents and radio-exchange analysis were found to be the best methods. The reagents best suited for the work were S^{35} and P^{32}. The methods investigated for the determination of Pb were: quantitative paper chromatography with P^{32}, which made the determination less sensitive to interferences; determination with P^{32} without preceding separations which, with certain restrictions, proved to be successful for the analysis of 0.01 μ equivalent of Pb; determination with diethyldithiocarbamate and Tl^{204} ions, which proved to be complicated owing to the co-extraction of diethyldithiocarbamate (DDC); and determination with Tl^{204} (DDC), which proved to be suitable for the analysis of 0.05 μg of Pb in addition to being simple and inexpensive. (P.C.H.)

23450 (PG-Report-199) ANALYTICAL METHOD FOR THE DETERMINATION OF PLUTONIUM IN REACTOR FUEL PROCESSING AND EFFLUENT PLANT SOLUTIONS (RAPID LANTHANUM FLUORIDE CO-PRECIPITATION). (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1961. 6p.

Plutonium is precipitated along with lanthanum fluoride. The precipitate is dispersed evenly on a stainless steel counting tray and the α activity is measured using standard α-scintillation counting equipment. The equipment is calibrated against standard sources. (auth)

23451 (PG-Report-203) ANALYTICAL METHOD FOR THE DETERMINATION OF CERIUM-144 IN VEGETATION, SEAWEED, FISH FLESH, AND NATURAL WATERS. (United Kingdom Atomic Energy Authority. Production Group, Risley, Lancs, England). 1961. 10p.

Radio-cerium is co-precipitated on added carrier. After radiochemical purification, the Ce is precipitated as the oxalate and mounted on a counting tray. After growth to equilibrium of the daughter product Pr^{144}, the activity of this isotope is measured. The method is suitable for the determination of Ce^{144} in area survey samples of vegetation, seaweed, and fish flesh, and also in natural waters. In the last type of sample several other isotopes may be determined on the same sample portion. The method is therefore particularly useful when the sample size is limited or when the concentrations of these isotopes are very low. Large samples (40 to 50 liters) can be handled without resorting to tedious evaporation techniques. Detection limits are governed by natural background radiation which is dependent upon local conditions. The method has been applied to samples containing 2 to 2000 $\mu\mu$c Ce^{144} per sample portion. (auth)

23452 (PG-Report-204) ANALYTICAL METHODS FOR THE DETERMINATION OF IODINE-131 IN VEGETATION,

MILK, THYROID GLANDS AND NATURAL WATERS. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1961. 11p.

Radioiodine, together with added carrier, was separated by extraction as elemental iodine into carbon tetrachloride and back extracted as iodide into dilute sulfurous acid. The iodide was precipitated as the silver salt, mounted, and the β-activity was measured. The observed counting rate was corrected from background chemical yield and radioactive decay, and the activity of the original sample was calculated by comparison with a standard I^{131} source. This method was found to be suitable for the determination of I^{131} in area survey samples of vegetation, milk, animal thyroid glands, and water. (auth)

23453 (PG-Report-205) ANALYTICAL METHOD FOR THE DETERMINATION OF CERIUM-144 IN REACTOR FUEL PROCESSING AND EFFLUENT TREATMENT PLANT SOLUTIONS. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1961. 8p.

Cerium-144, with added water carrier, is extracted into tributyl phosphate. After back extraction and several purification steps, cerium is precipitated as cerous oxalate and its beta-activity is measured. (auth)

23454 (PG-Report-207) ANALYTICAL METHOD FOR THE DETERMINATION OF POLONIUM-210 IN EFFLUENT TREATMENT PLANT SOLUTIONS. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1961. 6p.

Polonium-210 is adsorbed on the MnO_2 produced in the solution, and the α-activity is measured. (auth)

23455 (PG-Report-211) ANALYTICAL METHOD FOR THE DETERMINATION OF NIOBIUM-95 IN REACTOR FUEL PROCESSING AND EFFLUENT TREATMENT PLANT SOLUTIONS. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1961. 9p.

Niobium-95 with added carrier is separated as niobic acid, ignited to niobium pentoxide, and the γ activity meas ured. (auth)

23456 (WADD-TR-60-185) RESEARCH ON ANALYTICAL METHODS FOR THE DETERMINATION OF OXYGEN IN BERYLLIUM. Silve Kallmann, Fred Collier, Robert Liu, and Hans Oberthin (Ledoux and Col, Teaneck, N. J.). Mar. 15, 1960. Contract AF33(616)-6281. 17p.

The inert gas fusion method is shown to be well suited for the determination of total oxygen in beryllium metal. In order to release the oxygen from the very refractory beryllium oxide it is necessary to use a medium in which beryllium metal is soluble. Among the methods based on differential solubility of beryllium, the bromine-methanol procedure was found superior. A limitation of the method is caused by the unspecificity of the reagent. (auth)

23457 (SCL-T-369) DOSAGE [DETERMINATION] OF URANIUM BY MEANS OF THE BETA-OXIME OF ISATIN. V. Hovorka and V. Sykora. Translated by Marcel I. Weinreich (Sandia Corp.) from Excerpts of Collection Czechoslov. Chem. Commun., 10: 182-9(1938). 8p.

Descriptions are given of the methods for preparing the uranyl salts, $UO_2(NO_3)_2 \cdot 6\ H_2O$ and $UO_2(CH_3COO)_2 \cdot 2\ H_2O$, the beta-oxime of isatin, and the solutions of the salts with isatoxim. The results of observations of the effects of various factors on the reactions in the solutions are tabulated. The determination of uranium in the nitrate was 47.58% compared to 47.41% theoretical, while for the acetate uranium analysis was 55.51% compared to 56.12% theoretical. (B.O.G.)

23458 USE OF TRITIUM TRACER FOR THE DETERMINATION OF HYDROGEN IN ALUMINUM. Arthur S. Gillespie, Jr. (Aluminum Co. of America, New Kensington, Penna.). Anal. Chem., 32: 1624-6(Nov. 1960).

Hydrogen, as tritium, extracted from aluminum by solid extraction methods and assayed in an ion chamber can be measured to a level of about 3×10^{-10} ml at STP. The method compares well with existing solid extraction methods for assaying nonradioactive hydrogen and is as reproducible. Sensitivity far exceeds existing methods and the radiochemical method requires no troublesome surface gas corrections. Tritium activities between 10^{-9} and 10^{-2} c can be measured routinely. Isotope effects were found only for the attack of condensed tritiated water on aluminum powder at room temperature. (auth)

23459 DETERMINATION OF CADMIUM IN ROCKS BY NEUTRON-ACTIVATION ANALYSIS. L. I. Bilefield and E. A. Vincent (University Museum, Oxford). Analyst, 86: 386-91(June 1961).

A neutron-activation method was developed for determining 0·1 to 1 ppm of Cd in rocks. It depends on the separation of Cd^{115} (half-life 55 hours) with added Cd carried from a solution of the irradiated powdered rock by successive precipitations with trimethylphenylammonium iodide, 5,6-benzoquinoline and brucine. The precipitates are re-dissolved in a mixture of H_2SO_4 and $HClO_4$, and the Cd is finally mounted for β counting as its brucinium salt. Standards are prepared by irradiating microgram amounts of Cd acetate. The method was applied to a suite of rocks from the Skaergaard Intrusion, Greenland, and also to the international standard rock samples G-1 and W-1. (auth)

23460 POLAROGRAPHIC DETERMINATION OF ANTIMONY IN REFINED LEAD. V. T. Athavale, R. G. Dhaneshwar, M. M. Mehta, and M. Sundaresan (Atomic Energy Establishment, Trombay, India). Analyst, 86: 399-401(June 1961).

The supporting electrolyte used is N sulfuric acid. Cu, Fe, and Bi do not interfere, and there is no interference from Sn even if present in amounts equal to the Sb. However, results for Sb are lower if Sn is present in higher ratios. The method can be used for determining as little as 10 ppm of Sb on a 1-g sample of Pb; the error is within ±5% in the concentration range above 25 ppm, but is greater in the lower range. (auth)

23461 THE FLUORIMETRIC DETERMINATION OF SMALL AMOUNTS OF URANIUM: AN IMPROVED FURNACE AND EXAMINATION OF PROCEDURE. Masanobu Sakanoue and Michio Ichikawa (Okayama Univ., Japan and Japan Atomic Fuel Corp.). Bunseki Kgaku, 10: 645-50 (June 1961). (In Japanese)

The fluorimetric method of analysis for uranium was examined by using improved equipments, and a standard method of analysis which can determine 0.02 ~ 30 μg uranium with high precision was established. A furnace, in which six platinum dishes containing the samples should rotate horizontally during the fusion of the fluoridecarbonate flux, was built and the conditions of the fusion and cooling of flux were examined. For the measurement of fluorescence, a transmission fluorimeter which can be attached to the Beckman DU type spectrophotometer was constructed and the most favorable combination of its primary and secondary filter was sought. Furthermore, several important points in the preliminary ethyl acetate extraction procedure for the elimination of interfering ele-

ments were pointed out. Ore samples were analyzed by this method. (auth)

23462 DETERMINATION OF RADIOIODINE IN MILK. Kristian Koren and Arne Bull (State Inst. of Radiation Hygiene, Oslo). Health Phys., 5: 225(June 1961).

Tests carried out with single-channel scintillation counters set at the I^{131} energy level proved encouraging. Using a preset time of 10 sec and a net count corresponding to half the background as a criterion, a detection level of 0.0004 $\mu c/l$ was established on the exterior wall of a 50 l container. The sensitivity and speed justify the cost of the equipment. (P.C.H.)

23463 ELECTRON BEAM MICRO-ANALYSIS OF SOME PLUTONIUM–IRON ALLOYS. V. D. Scott (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Nuclear Materials, 3: 284-93(Mar.-Apr., 1961). (In English)

A simple method, which involves first coating the specimen with a thin plastic film, permits the examination of plutonium in an unmodified commercially-made electron beam micro-analysis instrument, without placing it in a glove box. No contamination of the apparatus with radioactivity is experienced. The results obtained in this way concerning the micro-distribution of elements in a series of plutonium–iron alloys are presented and discussed. (auth)

23464 SPECTROGRAPHIC ANALYSIS OF RADIOACTIVE SOLUTIONS. J. Fialkowski and R. Plejewski (Polish Academy of Sciences, Inst. of Nuclear Research, Warsaw). Kernenergie, 4: 391-4(May 1961). (In German)

The spectral analysis of radioactive materials necessitates a guarantee of complete protective measures against the effects of the radiation. An apparatus for making the spectral analysis of β- and γ-active solutions with the "copper spark" method is described. (tr-auth)

23465 STUDIES OF THE WATER BALANCE WITH HEAVY WATER (DEUTERIUM OXIDE). IV. AN APPROVAL OF THE ESTIMATION METHOD OF DEUTERIUM CONCENTRATION IN BIOLOGICAL MATERIALS. Toru Jujii (Osaka City Univ. Medical School). Osaka City Med. J., 6: No. 1, 1-15(1960). (In English)

The principles of the determination of the deuterium concentration both by the temperature-float method and the mass-spectrometry are described in detail. The combustion method of preparation of the sample water in biological materials is re-examined, and the purification method of the sample water by vacuum distillation is discussed. The measurement of equilibrium temperature by the temperature-float method is reported. Description is made of the apparatus and the method of a hydrogen gas reduction from the sample water for the preparation of mass-spectrometry is discussed. The values of deuterium concentration of biological materials are measured by the temperature-float method and they are compared with those by mass-spectrometry. It is shown that a natural abundance of deuterium in biological materials is not different from that of ordinary water. It is 0.0153 atom %. (auth)

23466 THE CHELOMETRIC TITRATION OF TITANIUM IN THE PRESENCE OF NIOBIUM AND TANTALUM. E. Lassner and R. Scharf (Metallwerk Plansee AG., Reutte, Tirol, Austria). Talanta, 7: 12-17(Nov.-Dec., 1960). (In German)

The existence of a complex between diaminocyclohexanetetra-acetic acid and the peroxytitanyl ion is reported. The chelate compound is used in a titrimetric procedure for titanium, in which excess of DCTA is back-titrated with copper solution to a PAN end-point. There is no interference from niobium and tantalum. (auth)

23467 A STUDY OF SOME SOLVENTS AS MEDIA FOR THE HIGH FREQUENCY TITRATION OF WEAK ACIDS. E. L. Grove and W. S. Jeffery (Univ. of Alabama, [Tuscaloosa]). Talanta, 7: 56-64(Nov.-Dec., 1960). (In English)

Six solvents, with different basicities and dielectric constants, were studied to determine their suitability as media for high frequency (HF) titrations of weak acids. There is no definite correlation between the slopes of the HF response and conductance curves and the two properties of the solvent. The apparent strength of the acid or base in these solvents is not due to any single solvent property but it is a combination of the properties of the solute and the solvent. (auth)

23468 DEUTERIUM ANALYSIS BY INFRARED SPECTROPHOTOMETRY. R. N. Jones and Marjory A. MacKenzie (National Research Council of Canada, Ottawa). Talanta, 7: 124-6(Nov.-Dec. 1960). (In English)

The technique, together with improved procedures for handling volatile and hygroscopic liquid samples, is described. It was found possible with this technique to obtain satisfactory analyses of cyclo-pentanone-α,α-d_4(b.p.760mm 160°) and diacetyl-d_6(b.p.760mm 88°). (P.C.H.)

23469 DETERMINATION OF CALCIUM IN LITHIUM SALTS. Rodney L. Olsen (Iowa State Univ. of Science and Tech., Ames), Harvey Diehl, Peter F. Collins, and R. B. Ellestad. Talanta, 7: 187-94(Feb. 1961). (In English)

Two procedures are described for the determination of traces of calcium in lithium salts. In both procedures the calcium is titrated with very dilute EDTA, and the end-point is determined fluorometrically with Calcein as indicator. This titration is carried out in the presence of the lithium salt in one procedure; in the other, a preliminary separation of the calcium is made on the chelating exchange resin, Dowex A-1. (auth)

23470 THE QUANTITATIVE DETERMINATION OF URANYL ION BY MEANS OF THE URANYL-SENSITISED PHOTODECOMPOSITION OF OXALIC ACID. A. E. Taylor, G. D. Heckler, and Donald R. Percival (Idaho State Coll., Pocatello, Idaho). Talanta, 7: 232-6(Feb. 1961). (In English)

The uranyl-sensitized photodecomposition of oxalic acid is followed by the use of a modified Warburg constant-volume micro-manometric apparatus. The minimum concentration of uranyl ion determined was 100 μM. (auth)

23471 DETERMINATION OF CALCIUM IN BIOLOGICAL MATERIAL. THE USE OF CALCEIN AS AN INDICATOR IN THE EDTA TITRATION. Taft Y. Toribara and Larysa Koval (Univ. of Rochester, N. Y.). Talanta, 7: 248-52(Feb. 1961). (In English)

The EDTA titration of calcium using the change in fluorescence of Calcein indicator under ultraviolet illumination at the end-point was very satisfactory for essentially pure calcium chloride solutions. In order to use this method for biological samples, it was found best to separate the calcium by an oxalate precipitation at a pH of 4.7, convert the calcium oxalate to calcium carbonate, and dissolve the calcium carbonate in hydrochloric acid. (auth)

23472 PRECIPITATION AND DETERMINATION OF TANTALUM AND NIOBIUM FROM HOMOGENEOUS SOLUTION WITH 3:3′:4′:5:7-PENTAHYDROXYFLAVANONE. Frank L. Chan (Aeronautical Research Labs., Wright-Patterson AFB, Ohio). Talanta, 7: 253-63(Feb. 1961). (In English)

3:3′:4′:5:7-Pentahydroxyflavanone in fairly concentrated acidic solution(6–9N)does not precipitate tantalum and niobium; however, on heating or boiling, in the pres-

ence of air, this flavanone is transformed into 3:3':4':5:7-pentahydroxyflavone, which precipitates any tantalum and niobium present in the solution. Under the precipitation conditions, racemization of the flavanone also takes place. The racemized flavanone which is less soluble than the original d-form may accompany the tantalum and niobium precipitates without affecting the quantitative determination of these elements. The precipitation of the tantalum and niobium complexes can be controlled by regulating the acidity and the duration of boiling, as well as the concentration of the flavanone. Experimental data and procedures are given for the precipitation and determination from homogeneous solution of tantalum and niobium complexes. Zirconium and molybdenum do not interfere with the determination. Titanium must be absent or present only in minute quantity. Since the generation of the precipitating reagent, flavone, from the flavanone is comparatively slow, the precipitation of tantalum and niobium is uniform throughout the solution. By this technique, adsorption and co-precipitation of potassium and sulfate ions in the solution are shown to be negligible. This is in contrast to the less effective dropwise addition of the flavone reported by earlier investigators, in which adsorption and co-precipitation were pronounced. In the present study, tantalum and niobium oxides were fused with potassium bisulfate. There is no necessity of using hydrofluoric acid to dissolve these oxides, and therefore no polyethylene apparatus is required. (auth)

23473 SPECTROPHOTOMETRIC DETERMINATION OF RHENIUM WITH 4-METHYLNIOXIME. James L. Kassner, Shih-Fan Ting, and E. L. Grove (Univ. of Alabama, University). Talanta, 7: 269-75(Feb. 1961). (In English)

A simple method applicable to the spectrophotometric determination of less than 0.001% to more than 1.0% of rhenium in molybdenite concentration and in "molybdenite roaster flue dust" has been developed. Interfering elements commonly found in these materials are removed in three operations: evaporation with hydrochloric acid, precipitation of hydrous oxides with ammonia, and formation of organometallic compounds with ethyl xanthate and chloroform extraction. The method is based on the formation of a soluble, stable, yellow-green rhenium-4-methylnioxime chelate where rhenium^{VII} is reduced by tin^{II} chloride in a dilute hydrochloric acid solution in the presence of 4-methylnioxime (4-methyl-1:2-cyclohexanedionedioxime). The color develops in less than 5 min and the chloroform extract shows a maximum absorption at 436 mμ. The calibration curve conforms to Beer's law. The molar extinction coefficient for rhenium-4-methylnioxime is about 6.89×10^4 as compared to less than 4.5×10^4 reported for other methods for rhenium. (auth)

23474 DETERMINATION OF RADIOACTIVE COBALT IN MIXTURES OF RADIONUCLIDES. Richard B. Hahn and David L. Smith (Wayne State Univ., Detroit). Talanta, 7: 291-5(Feb. 1961). (In English)

A detailed procedure for the separation of radiocobalt from other active material is described. Precipitation as the mercurithiocyanate and as the anthranilate have been compared, and the latter has been shown to be somewhat preferable. (auth)

23475 SPECTROPHOTOMETRIC METHODS FOR THE DETERMINATION OF OSMIUM. I. EXTRACTION AND ULTRAVIOLET SPECTROPHOTOMETRIC DETERMINATION OF OSMIUM TETROXIDE. Gerald Goldstein (Oak Ridge National Lab., Tenn.), D. L. Manning, Oscar Menis, and J. A. Dean. Talanta, 7: 296-300(Feb. 1961). (In English)

An ultraviolet spectrophotometric method is presented for the determination of milligram quantities of osmium in solutions of uranyl sulfate. Osmium is first oxidized to the octovalent state, and the osmium tetroxide which is formed is selectively extracted with chloroform. The ultraviolet absorption spectrum of osmium tetroxide in chloroform has a series of absorption bands with peak absorbancies at 282, 289, 297, 304, and 312 mμ and molar absorbancy indexes of 1870, 1760, 1640, 1400, and 1000, respectively. For each wavelength, the optimum concentration range for the determination of osmium was evaluated. From 0.4 to 3.3 mg of osmium can be determined with a coefficient of variation of 3%. Of the elements tested only chloride and octovalent ruthenium interfere; however, both of these interferences can be eliminated. (auth)

23476 SPECTROPHOTOMETRIC METHODS FOR THE DETERMINATION OF OSMIUM. II. EXTRACTION AND DETERMINATION OF OSMIUM IN SITU WITH 1,5-DIPHENYLCARBOHYDRAZIDE. Gerald Goldstein (Oak Ridge National Lab., Tenn.), D. L. Manning, Oscar Menis, and J. A. Dean. Talanta, 7: 301-6(Feb. 1961). (In English)

A method has been developed for the spectrophotometric determination of microgram quantities of osmium in uranyl sulfate solutions. The osmium is oxidized to osmium tetroxide, then extracted with chloroform. The extracts are added to an ethanolic solution of 1:5-diphenylcarbohydrazide. A blue-violet colored reaction product is formed which exhibits maximum absorbancy at 560 mμ. After a period of 2 hr for color development the molar absorbancy index is about 31,000. Beer's law is adhered to over a range of 30 to 100 μg of osmium with a coefficient of variation of about 4%. A study was made of the effects of foreign substances and only chloride and octovalent ruthenium were found to interfere. Both of these interfering ions can be eliminated. (auth)

23477 SPECTROPHOTOMETRIC METHODS FOR THE DETERMINATION OF OSMIUM. III. REACTION OF OSMIUM TETROXIDE WITH 1:5-DIPHENYLCARBOHYDRAZIDE IN AQUEOUS SOLUTIONS FOLLOWED BY EXTRACTION OF THE COMPLEX. Gerald Goldstein (Oak Ridge National Lab., Tenn.), D. L. Manning, Oscar Menis, and J. A. Dean. Talanta, 7: 307-15(Feb. 1961). (In English)

A spectrophotometric method has been developed which is applicable to the determination of extremely small quantities of osmium. Osmium is oxidized to the octovalent state, then added to an acidic aqueous solution containing 1:5-diphenylcarbohydrazide (DPC). After heating the aqueous solution to 65°, the osmium-DPC complex is extracted with chloroform. A molar absorbancy index of about 150,000 is obtained. From 7 to 25 μg of osmium can be determined with a coefficient of variation of 6%. It was established that Fe^{III}, Cu^{II}, Ru^{III}, and Au^{III} seriously interfere in the determination of osmium by this method, while Cr^{VI}, Ni^{II}, Mo^{VI}, Ir^{III} and chloride interfere only when present in relatively high concentrations. (auth)

General Inorganic and Physical Chemistry

23478 (AWRE/LIB/BIB/3 HYDROGEN ABSORPTION AT LIQUID NITROGEN TEMPERATURES—BIBLIOGRAPHY OF REFERENCES TO PUBLISHED ARTICLES. Dorothy Beck. (United Kingdon Atomic Energy Authority Weapons Group. Atomic Weapons Re-

search Establishment, Aldermaston, Berks, England). July 1961. 9p.

The principal sources for the 42 references included are: CA 1952 to 1958; NSA 1952 to July 1960; J. Phys. Chem. 1959 to August 1960; and Russian J. Phys. Chem. July 1959 to Jan. 1960. Details from the abstracts are given. (P.C.H.)

23479 (IDO-16674) THERMAL STABILITY OF GADOLINUM NITRATE SOLUTION AT HIGH TEMPERATURE. J. F. Koenig (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). May 19, 1961. Contract AT(10-1)-205. 6p.

During a feasibility study of auxiliary shutdown systems for the Spert II and Spert III reactor facilities, salts possessing high neutron absorption cross sections were considered for use in water soluble poison injection systems, and gadolinium nitrate appeared promising. Tests were carried out in a high pressure static autoclave to determine the stability of gadolinium nitrate solution at elevated temperature. At temperatures of 300°F and above, the solution decomposed with formation of a white precipitate. It was concluded that gadolinium nitrate is unsuitable for use as a soluble poison in high temperature, water-moderated reactor systems. (auth)

23480 (LAMS-2526(p.302-5)) DETERMINATION OF THE HYDROLYSIS RATE OF HAFNIUM TRITIDE. T. T. Trujillo and W. H. Langham (Los Alamos Scientific Lab., N. Mex.).

Preliminary results indicate the hydrolysis rate of HfT_2 is very slow. The potential hazards of handling HfT_2 are discussed briefly. (C.H.)

23481 (TID-13085) THE REACTION OF URANIUM WITH SOME OXIDIZING AGENTS IN LIQUID AMMONIA. Final Technical Report. Robert Joseph Kline (Ohio Univ., Athens). June 1, 1961. Contract AT(11-1)-362. 36p.

A study was conducted to determine the conditions and effective oxidizing agents for carrying out redox reactions with uranium in anhydrous liquid ammonia. It was concluded that silver(I), copper(I), and mercury(II) salts offered the most promise as oxidizing agents. The results of the reactions carried out at 20°C are tabulated. (B.O.G.)

23482 (UCRL-6444) THE PREPARATION AND IDENTIFICATION OF N-FLUORO-N'-TRIFLUOROMETHYLDIAZINE-N'-OXIDE. Jack W. Frazer, Bert E. Holder, and Earl F. Worden (California. Univ., Livermore. Lawrence Radiation Lab.). May 8, 1961. Contract W-7405-eng-48. 18p.

The compound N-fluoro-N'-trifluoromethyldiazine-N'-oxide (CF_3NONF) was prepared from the reaction of CF_3I, NO, and N_2F_4 by ultraviolet and thermal activation. Its structure is shown to be $CF_3-\overset{O}{\overset{|}{N}}=NF$. (auth)

23483 (UCRL-9709) THE PREPARATION OF SOME GERMANIUM HYDRIDES. John E. Drake (California. Univ., Berkeley. Lawrence Radiation Lab.). May 18, 1961. Contract W-7405-eng-48. 20p.

The preparation of germanium hydrides, by the dropwise addition of al alkaline solution of hydroborate and germanate to aqueous acid, was studied systematically. As much as 70% of the germanium in solution could be converted to germane. Digermane, trigermane, and a polymeric germane were also obtained, and the infrared absorption spectra of gaseous trigermane and of polymeric germane were recorded. (auth)

23484 (AEC-tr-4758) INORGANIC PERIOXIDES. CHAPTER 11—UPPER POTASSIUM OXIDES. I. A. Kazarnovskii and S. I. Raikhshmein. Translated for Oak Ridge National Lab. from Zhur. Fiz. Khim., 21: 245-55(1947). 15p.

Further investigations of the x-ray structure and magnetic properties of potassium tetraoxide produced the formulas KO_2 and the O_2^- ion. On the basis of tensimetric measurements of potassium trioxide-K_2O_3 is shown to be a mixture of KO_2 and K_2O_2. The existence of only 3 potassium oxides—K_2O, K_2O_2, and KO_2 is confirmed. The thermal properties of the potassium oxides was examined. (P.C.H.)

23485 (AERE-Trans-865) INVESTIGATION OF GASIFICATION PROCESSES OF SOLID FUEL BY AN ISOTOPE METHOD. I. G. Petrenko. Translated by J. J. Cornish for U.K.A.E.A., Atomic Energy Research Establishment from Trudy Inst. Goryuchikh Iskopaemykh, Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, 11: 9-22(1959). 20p.

The investigation shows that with interaction between carbon and carbon oxides several interconnected parallel and successive reactions take place with the formation on the surface of the carbon of at least 3 compounds. Exchange reactions between CO and CO_2, and also between elemental carbon and its oxides, make it possible to specify the complex mechanism of the interaction between carbon and carbon oxides. The isotope method also shows that the oxidation of CO proceeds comparatively easily in the presence of a solid fuel. This is explained by the formation on the surface of the coal of oxides of the keto-group type with which CO easily interacts, which is the reason for the retardation of the reaction of reducing CO_2 with CO and the acceleration of the reaction of oxidizing CO in the presence of a solid fuel. (P.C.H.)

23486 (AERE-Trans-866) ANALYSIS OF THE PROCESS OF COMBUSTION OF CARBON IN A BED BY THE METHOD OF SIMILARITY. G. Ya. V'Yugova and Ya. I. Chesnokov. Translated by D. Finch (United Kingdom Atomic Energy Authority) from Trudy Inst. Goryuchikh Iskopaemykh, Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, 11: 133-8(1959). 12p.

By means of the similarity method and certain criteria, the combustion of electrode carbon in a bed with blasts containing different concentrations of oxygen, including air blasts, was examined and analyzed using previously determined data. It was confirmed that the process was intensified as effectively by an increased oxygen content in the blast as by an increase in the blast rate. In both cases a higher temperature is attained in the bed, while the oxygen and reduction zones and the burning-out time of the bed are shortened. The process of gasification using chemical models with particles of soda lime reacting with a flow of air containing variable quantities of CO_2 was also investigated. A general relation between the relative bed temperature and the concentration of CO_2 was then obtained. (P.C.H.)

23487 (CEA-tr-A-955) DENSITE DE L'EAU LOURDE ENRICHIE EN ISOTOPES DE L'OXYGENE DETERMINEE PAR UNE METHODE ELECTROLYTIQUE. (Density of Heavy Water Enriched in Oxygen Isotopes Determined by Electrolytic Method). P. Isberg and L. Lundberg. Translated into French from Z. Naturforsch,, 9: 472-3(1954). 7p.

Experimental data on the absolute value of the content of O^{18} in Stockholm drinking water were used to evaluate the density of D_2O for a normal O^{18}/O^{16} isotopic ratio. The density for various temperatures up to 100°C is tabulated and compared with other results. (J.S.R.)

23488 (CEA-tr-R-1089)) APPLICATION DE LA METHODE ELECTROCHIMIQUE POUR LA DETERMINATION DE LA SOLUBILITE DE L'HYDROXYDE DE POLONIUM. (Application of the Electrochemistry Method for Determination of the Solubility of Polonium Hydroxide). D. M. Ziv, V. S. Ziv, and G. S. Sinitsyna (Sinitzina). Translated into French from Trudy Radievogo Inst. im. V. G. Khlopina, 8: 158-62(1958). 13p.

Cathodic release of polonium in neutral medium is produced at a slower speed than in 0.1 N HCl. At concentrations of 2.5×10^{-13} and of 5.4×10^{-12} mole/l, polonium is in the dissolved state. The release potentials increase regularly with increased polonium concentration in the solution, complying with the release of the tetravalent polonium ion. During the variation of polonium concentration from 5.0×10^{-1} to 1.5×10^{-7} mole/l, the electrode potential Po_{metal}/Po^{4+} remains constant. The solubility of the hydrolysis product of the tetravalent polonium salt, determined by electrochemical methods, and of its hydroxide is 10^{-10} mole/l, which corresponds for a hydroxide such as $Po(OH)_4$ to a solubility product $\sim 10^{-38}$. The existence in neutral medium of colloidal solutions of polonium was confirmed. (tr-auth)

23489 (CEA-tr-R-1090) DETERMINATION DU POTENTIEL DE SEPARATION DU POLONIUM SUR LE PLATINE. (Determination of the Potential for Separation of Polonium on Platinum). D. M. Ziv and G. S. Sinitsyna. Translated into French from Trudy Radievogo Inst. im. V. G. Khlopina, 8: 138-40(1958). 10p.

It was established that the separation of polonium on platinum has a completely fixed electrochemical character. The potential for the separation of polonium on platinum with 0.1 N HCl at a polonium concentration of 10^{-10} mol/l is 1.327 ± 0.003 v. It was indicated that a bonding of the polonium with the surface of the platinum or its introduction in place of the support was observed with time. (tr-auth)

23490 (CEA-tr-R-1241) CINETIQUE DE LA REACTION DU GAZ CARBONIQUE SUR LE CARBONE ET ECHANGE ISOTOPIQUE. (Reaction Kinetics of Carbon Dioxide with Carbon and Isotopic Exchange). V. A. Evropin, N. V. Kul'kova, and M. L. Temkin. Translated into French from Zhur. Fiz. Khim., 30: 348-65(1956).

The kinetics of CO_2 reaction on C (bakelite carbon without ashes) was studied at different CO_2 pressures and temperatures. The specific surface of the carbon samples was measured. From the variation of the reaction speed with the dimensions of the carbon grains, the kinetic domain of the reaction was shown. The reaction velocity equation proposed by Semechkova and Frank-Kameneskii does not quantitatively represent the results obtained. The experimental results are well represented by an equation with fractional exponents. The velocity of the isotopic exchange of O_2 between CO_2 and CO was measured at equilibrium conditions among CO, CO_2, and C. It was established that the total exchange velocity of O_2 between CO_2 and CO exceeds several times that of the reaction of CO_2 and C in equilibrium conditions. The results on the reaction kinetics and the isotopic exchange confirm a "step-wise" reaction mechanism. A kinetic equation was introduced for the velocity of the reaction $CO_2 + C \rightarrow 2CO$. The Frank-Kameneskii hypothesis was used, but the surface heterogeneity was taken into consideration. An equation for the velocity of isotopic exchange was proposed. The kinetic equation is in agreement with the experimental results on the reaction of CO_2 and C, and the kinetics of this reaction agree with the results on isotopic exchange. From the isotopic exchange results, it was shown that the inhibition of the reaction $CO_2 + C \rightarrow 2CO$ by its product is caused by the reversibility of the first stage of the reaction. (tr-auth)

23491 (CEA-tr-R-1253) SUR LES CAUSES DE L'OXYDATION DE L'URANIUM DANS LES URANINITES. (On the Causes of Oxidation of Uranium in Uraninites). V. I. Lebedev. Translated into French from Zapiski Vsesoyuz. Mineral. Obshchestva, 88: 667-71(1959). 14p.

The principal causes of uranium oxidation in uraninites are self-oxidation of the uraninite during the process of radioactive decay of uranium and Pb formation and the process of further oxidation by uranium migration. The mechanisms of these processes are discussed in detail. (J.S.R.)

23492 (CEA-tr-R-1256) LE COMPORTEMENT DU BERYLLIUM DANS LES CHLORURES FONDUS: EN PRESENCE DU BERYLLIUM METALLIQUE. (The Behavior of Beryllium in Fused Chlorides, in Presence of Metallic Beryllium). M. V. Smirnov and N. Ya. (J.) Chukreev. Translated into French from Zhur. Neorg. Khim., 4: 1168-72(1959). 27p.

It was shown that the reduction of bivalent beryllium in fused electrolytes by the metal can be observed by the variation of the redox potential of the system (molybdenum electrode placed in the fused electrolyte) reaching a value of 1.4 v. The equilibrium constant of the reaction Be^{2+} (fused) + Be $\rightleftharpoons 2Be^{+}$(fused) in fused electrolytes composed of alkaline metal chlorides was determined at various temperatures. From experimental data an empirical expression giving the equilibrium constant as a function of temperature was found: $\log K = (2.36 - 4904/T) \pm 0.10$. It was established that the introduction of fluorine ions in the electrolyte strongly displaces the equilibrium of the reaction in the direction of the bivalent beryllium. (tr-auth)

23493 (CEA-tr-R-1279) ETUDE EXPERIMENTALE DE LA CHALEUR SPECIFIQUE DE L'EAU LOURDE. (Experimental Studies on the Specific Heat of Heavy Water). S. L. Rivkin (Rivku) and B. N. Egorov. Translated into French from Atomnaya Energ., 7: 462-4(1959). 10p.

The specific heat of heavy water was studied by the method of adiabatic calorimetry with closed circuit circulation. The experimental apparatus is described in some detail, and the method of measurement is indicated. The apparatus was calibrated by remeasuring the specific heat of H_2O. The specific heat of D_2O was studied for 50 and 100 kg/cm^2 isobars and between 50°C and a temperature close to the saturation temperature at the corresponding pressure. The absolute specific heat was calculated, and the results are tabulated. The ratios of the specific heats of D_2O and H_2O for pressures of 50 and 100 kg/cm^2 were determined as a function of temperature. This ratio does not appear to depend on pressure but decreases when the temperature increases. (J.S.R.)

23494 (CEA-tr-R-1303) ETUDE EXPERIMENTALE DE LA VISCOSITE DE L'EAU LOURDE. (Experimental Studies on the Viscosity of Heavy Water). D. L. Timrot and K. F. (Ph.) Shuiskaya (Schoniskaia). Translated into French from Atomnaya Energ., 7: 459-61(1959). 15p.

The viscosity of heavy water was measured by the capillary method at temperatures from 25 to 283°C and at pressures between 45 and 325 kg/cm^2. The experimental apparatus and techniques are described in detail. The results are tabulated and show that the ratio of the viscosity coefficient of D_2O to the viscosity coefficient of H_2O decreases when the temperature increases. The results are compared with previous results. (J.S.R.)

23495 (UCRL-Trans-667(L)) ON THE STATISTICAL THEORY OF CONCENTRATED SOLUTIONS OF STRONG ELECTROLYTES. A. E. Glauberman and I. R. Yukhnovskii (Iukhnovskii). Translated by Stephen G. Brush (Univ. of California. Lawrence Radiation Lab.) from Zhur. Eksptl'. i Teoret. Fiz., 22: 562-78(1952). 23p.

I. A system of interacting ions is considered by Bogolyubov's method, the system as a whole being electrically neutral; the presence of the solvent is considered by introducing into the law of ion interactions the dielectric constant of the solution. The introduction of an interaction potential which qualitatively accounts for repulsive forces and does not contain the Coulomb term at small interionic distances removes mathematical difficulties. A general formula is obtained for higher approximations to the binary distribution function. The zeroth and first approximations are determined. The zeroth approximation for the binary function is investigated with regard to its dependence on the concentration of the solution. II. A formula is also obtained for the activity coefficient, which reduces to the Debye law for very dilute concentrations. The equation derived from the theory is compared with experimental data. (auth)

23496 A STATE EQUATION FOR LIQUID HEAVY WATER. Rudolf Plank (Technische Hochschule, Karlsruhe, Ger.). Brennstoff-Wärme-Kraft, 13: 257-8(June 1961). (In German)

An empirical formula is found relating the pressure, temperature, and specific volume of liquid D_2O. The formula contains six empirical constants and is accurate to within 1% at temperatures up to 379°C and pressures above 100 kp/cm^2. The formula is invalid near the critical point. (T.F.H.)

23497 CHEMICAL PROPERTIES OF SOME VANADIUM COMPOUNDS IN ALKALINE CHLORIDE MELTS. Roger Molina (Ecole de Physique et Chimie, Paris). Bull. soc. chim. France, 301-8(1961). (CEA-1946). (In French)

The values of the solubility products of some oxides in molten LiCl–KCl eutectic are given. After a discussion of the probable forms in which the different oxidation states of V exist, the constants are given for some complexes and for the O^{2-} ion measured semi-quantitatively. These made it possible to establish the theoretical diagram (E,pO^{2-}) for the oxydo-reduction system V^{4+}/V^{5+}. Chemical reactions illustrate the predictions possible from a knowledge of the diagram and the constants given. (auth)

23498 IMPROVING CESIUM SELECTIVITY OF BENTONITES BY HEAT TREATMENT. T. Tamura and D. G. Jacobs (Oak Ridge National Lab., Tenn.). Health Phys., 5: 149-54(June 1961).

Selectivity for Cs was improved by heating montmorillonites to 600 to 700°C. The optimum temperature depends on the saturating cation and bentonite type. For montmorillonites heated in this temperature range and at higher temperatures, clay–solution contact time was an important consideration. Sorption characteristics over a wide range of Cs concentration were investigated; the results suggested a multifunctional exchange reaction for the 600°C calcium–montmorillonite and a simple mass action reaction for the oven-dried calcium–montmorillonite. The study of the influence of heating periods at 600°C for calcium–montmorillonite showed that longer heating periods resulted in a decreasing degree of initial sorption; however, Cs sorption gradually increased with solution–clay contact time and eventually exceeded the cesium sorption of oven-dried samples. (auth)

23499 OSMOTIC COEFFICIENTS AND ACTIVITY COEFFICIENTS IN MIXED ELECTROLYTE SOLUTIONS. George Scatchard (Massachusetts Inst. of Tech., Cambridge). J. Am. Chem. Soc., 83: 2636-42(June 20, 1961).

The excess free energy per mole of ionic strength in mixed electrolyte solutions is expressed as a linear function of this property of the solutions of single electrolytes at the same ionic strength, plus a quadratic term in the ionic strength fractions and plus higher deviation terms of the expansion around the midpoint, of which the cubic term is usually sufficient. Other properties are obtained by appropriate differentiations, the osmotic coefficients and activity coefficients by differentiation with respect to the logarithm of the ionic strength. The method is applied to freezing points, isopiestic, and solute activity measurements. The deviations from linearity in ionic strength fraction are relatively smooth functions of the ionic strength which may be expressed approximately as integral power series. The relatively complicated linear terms may usually be expressed approximately by the Debye–Hückel functions with a different size parameter for each electrolyte plus integral power series in the ionic strength. The relations of this method to Brønsted's principle of specific ion interaction, to Harned's rule and Friedman's application of the Mayer theory are discussed. (auth)

23500 STASTICAL THERMODYNAMICS OF MIXTURES. II. CONVERGENCE OF THE QUASI-CHEMICAL METHOD FOR THE ISING SQUARE LATTICE. Stephen G. Brush (Univ. of California, Livermore). J. Chem. Phys., 34: 1852-3(1961). (UCRL-5842-T)

The quasi-chemical approximation of Guggenheim for calculating the thermodynamic properties of the Ising model is discussed. The Ising model is where a system of atoms is arranged on a lattice with simple nearest-neighbor interactions. This model provides a more or less realistic description of many physical systems. For convenience a calculation is made of a mixture of two kinds of atoms, A and B, the forces between the atoms being such that a (nearest-neighbor) AB pair has an energy larger by an amount ϵ than the average of an AA or BB pair. The method was chosen because it provides a sequence of approximations which is believed to converge to the exact solution. (N.W.R.)

23501 THE HYDROLYSIS OF ACETIC ANHYDRIDE. PART VI. KINETICS IN DEUTERIUM OXIDE SOLUTION. A. R. Butler and V. Gold (Univ. of London). J. Chem. Soc., 2305-12(June 1961).

The velocities of the spontaneous and acetate-catalyzed hydrolyses of acetic anhydride are reduced (by factors of 2.9 and ~1.7, respectively) on changing from ordinary water to deuterium oxide as solvent. The formate-catalyzed reaction is only slightly affected by the change of solvent. A reaction mechanism is put forward which accommodates the isotope effects and, at the same time, provides an explanation of the catalytic effect of acetate ions in this reaction. The rate-controlling step in this mechanism is a proton-transfer from hydrogen ion or acetic acid to the oxygen atom of an anionic intermediate. The general admissibility of a rate-determining step of this kind in a measurably slow reaction is discussed. (auth)

23502 THE SOLUBILITY OF PLUTONIUM TRIFLUORIDE, PLUTONIUM TETRAFLUORIDE, AND PLUTONIUM (IV) OXALATE IN NITRIC ACID MIXTURES. C. J. Mandleberg, K. E. Francis, and R. Smith (Rank Precision Industries, Ltd., London). J. Chem. Soc., 2464-8(June 1961).

The solubility of plutonium trifluoride was measured in

mixtures of nitric and hydrofluoric acids of various molarities and tetrafluoride in nitric acid. The effect of fluoride ion on the solubility is discussed and an attempt made to estimate the solubility product of each compound. On the basis of available data, the solubility products appear to be trifluoride 2.5×10^{-16} and tetrafluoride 6×10^{-20}. The solubility of plutonium(IV) oxalate was determined in mixtures of nitric acid up to 3.52M and oxalic acid up to 0.6M. The minimum solubility occurs in 1M nitric acid to 0.01M oxalic acid, but there is evidence that after 2 to 3 weeks' equilibration in this mixture an abnormal effect leads to anomalous solubilities. (auth)

23503 REACTIONS OF URANIUM AND SOME URANIUM COMPOUNDS WITH NITROSYL CHLORIDE, AND WITH LIQUID NITROSYL CHLORIDE–DINITROGEN TETROXIDE MIXTURES. C. C. Addison and N. Hodge (The University, Nottingham, Eng.). J. Chem. Soc., 2490-6(June 1961).

Uranium does not react with liquid dinitrogen tetroxide, but does react when nitrosyl chloride is added. Uranyl compounds are always formed in the presence of dinitrogen tetroxide. At all concentrations up to 85% of NOCl, the product is the addition compound $UO_2(NO_3)_2,N_2O_4$. At higher concentrations of nitrosyl chloride, a compound UO_2Cl_2,NOCl is produced (which is the corresponding compound on the nitrosyl chloride solvent system), but nitrate is present in the product at all concentrations below 98% NOCl. In pure nitrosyl chloride the uranium(IV) oxidation state is stable, and uranium reacts with the liquid to give UCl_4,xNOCl; x is usually ~2, but its variability suggests that 1:1 and 1:3 solvates may also exist. The nitrosyl chloride addition compounds have high thermal stability and are probably ionic complexes. These reactions of uranium metal are correlated by reference to the reactions of nitrosyl chloride with uranyl chloride, uranium tetra- and penta-chloride, the oxides UO_3 and U_3O_8, and uranyl nitrate–dinitrogen tetroxide, and to the solvolysis of uranium tetra- and penta-chloride by dinitrogen tetroxide. (auth)

23504 THE PREPARATION OF COMPLEX FLUORIDES BY USE OF SULPHUR TETRAFLUORIDE AS FLUORINATING AGENT. R. D. W. Kemmitt and D. W. A. Sharp (Imperial Coll. of Science and Tech., London). J. Chem. Soc., 2496-8(June 1961).

Sulfur tetrafluoride converts mixtures of alkali-metal fluorides and metal oxides, sulfides, and carbonyls into complex fluorides. Silver, thallous, and ammonium salts can also be prepared by use of this reagent. (auth)

23505 A POLAROGRAPHIC STUDY OF RHODIUM IN THIOCYANATE SOLUTIONS. Danilo Cozzi and Francesco Pantani (Università, Pisa, Italy and Università, Florence). J. Electroanal. Chem., 2: 230-6(May-June 1961). (In English)

A well-defined irreversible polarographic step is obtained from thiocyanate solutions of rhodium. The process is a three-electron reduction from Rh^{3+} to the metal. The effects of varying the maximum suppressors, temperature, Rh^{3+}, and CNS^- concentrations are widely investigated. The irreversibility of the wave was analyzed using Delahay's method. Study of the absorption spectrum, the behavior toward ion exchange resins and extraction with isoamyl alcohol enabled an evaluation of the complexes in solution to be made. (auth)

23506 THE POLARIZATION OF METALS IN BOILING, DISTILLED WATER. J. E. Draley, F. E. DeBoer, and C. A. Youngdahl (Argonne National Lab., Ill.). J. Electrochem. Soc., 108: 622-8(July 1961). (ANL-FGF-238)

A survey of the polarization behavior (cathodic and anodic) of sixteen metals in boiling, distilled water is presented. For the current densities used, no simple relation such as the Tafel plot described the dependence of E on I. For many metal-water systems reliable and reproducible data were obtained. (auth)

23507 QUANTUM EFFECTS IN THE LIQUID STATE BY MEANS OF A PHENOMENOLOGICAL CELL MODEL: THE VAPOUR PRESSURE RATIO OF Ne AND Ar ISOTOPES. R. Fieschi and N. Terzi (Università, Milan). Physica, 27: 453-64(May 1961). (In English)

Quantum effects on the vapor pressure of argon and neon isotopes in the liquid state are evaluated by means of two semi-empirical cell models. The space arrangements of atoms around the cell are obtained from the experimental data on the radial distribution function. The energy levels of the oscillators, appearing in the quantum partition function, are calculated in the anharmonic approximation. At the triple point the results are higher than theoretical predictions, although they should be lower. This comparison points out the limits of lattice-cell models even at high densities, in spite of the fact that some agreement is found with the experimental data. (auth)

23508 MAGNETO-RESISTANCE IN SUPERFLUID LIQUID HELIUM. G. Severne (Université, Brussels). Physica, 27: 465-78(May 1961). (In English)

A study is made of the very slightly ionized hard-sphere Bose gas (e.g. He II), in a uniform magnetic field B at 0°K. The properties of this gas are examined, during the time in which it is approaching equilibrium. The magneto-resistance that is observed in He II is remarkable, in that the proper resistance of the system is zero. In solids at 0°K, the B-field modifies the diffusion mechanism. In He II, however, the B-field actually creates the diffusion mechanism. It is shown that the system's relaxation time is proportional to B^{-3}. (T.F.H.)

23509 A NEW TYPE OF BORON HYDRIDE, $B_{10}H_{16}$. Russell Grimes, Frederick E. Wang, Ruth Lewin, and William N. Lipscomb (Harvard Univ., Cambridge, Mass.). Proc. Natl. Acad. Sci. U. S., 47: 996-8(July 1961).

The preparation, structure, and properties are reported for a boron hydride ($B_{10}H_{16}$) that contains a direct B-B bond between B atoms neither of which has a terminal H atom. This structural feature, not present in the known hydrides, probably dominates the chemistry of this new hydride and very likely gives rise to new types of reactions. (C.H.)

23510 CATION-EXCHANGE STUDIES OF LEAD^{II} ON DOWEX 50W-X8. SEPARATION FROM MIXTURES. Shripad M. Khopkar and Anil K. De (Jadavpur Univ., Calcutta). Talanta, 7: 7-11(Nov.-Dec. 1960). (In English)

Quantitative studies are reported on the behavior of Pb^{2+} at milligram levels, using cation-exchange resin Dowex 50W-X8. Various eluents, such as nitric acid, ammonium acetate, sodium nitrate, tartaric acid, citric acid, ethylenediaminetetra-acetic acid (disodium salt), and perchloric acid, are used for column operation. Two hundred ml of 2M nitric acid or ammonium acetate is sufficient for quantitative elution of lead from 1.4 × 14.5 cm of Dowex 50W-X8 resin. The efficiency of the various eluents is evaluated in terms of their elution constants. Pb^{2+} is separated from barium, strontium, and aluminum by selective elution with ammonium acetate (1M) and from Ce^{4+}, Zr^{4+}, Th^{4+}, Bi^{3+}, and Fe^{3+}, by converting the latter into suitable anionic complexes. (auth)

23511 CO-PRECIPITATION IN SOME BINARY SULPHATE SYSTEMS. Allen I. Cohen (Syracuse Univ., N. Y.)

and Louis Gordon. Talanta, 7: 195-211(Feb. 1961). (In English)

Studies have been made of the distribution behavior of tracers with alkaline earth sulfates, using the technique of precipitation from homogeneous solution. The co-precipitation of strontium with barium sulfate and of lead, lanthanum, and yttrium, separately, with barium sulfate and with strontium sulfate were investigated. Although there was qualitative correlation between the observed values of the distribution coefficient and the theoretical solubility product ratios for each of the binary systems studied, the divergence between theory and observation was so great that it seems unlikely that there is any quantitative correlation. (auth)

23512 BERYLLIUM PREPARATION BY THE FLUORIDE PROCESS. Tek. Tidskr., 91: 387-9(Apr. 14, 1961). (In Swedish)

23513 TRANSITION STATES AND ISOTOPE EFFECTS IN PROTON-TRANSFER REACTIONS. R. P. Bell (Brookhaven National Lab., Upton, N. Y. and Physical Chemistry Lab., Oxford). Trans. Faraday Soc., 57: 961-4(June 1961).

Simple models are used to calculate the curvatures of the energy surface for the transition state of proton-transfer reactions. One of these curvatures is related to the transverse vibration of the transition state, and the other to the tunnel effect. The results indicate that for a coulombic model the contribution of the transverse vibration to the isotope effect will be exactly cancelled by that of the tunnel effect, provided that both contributions are small. Under other conditions the tunnel effect will be the more important of the two. (auth)

23514 SOLUBILITY OF TRIPLE SUBSTITUTED URANYL PHOSPHATES. V. I. Karpov. [USSR]. Zhur. Neorg. Khim., 6: 531-3(Mar. 1961). (In Russian)

The solubility of uranyl phosphate $(UO_2)_3(PO_4)_2 \cdot 6H_2O$ (prepared by adding of 0.7 mol/l orthophosphoric acid to 0.042 mol/l uranyl nitrate, molar ratio $UO_2(NO_3)_2 : H_3PO_4 = 4 : 3$ at 40°) in aqueous and acid solutions was 4.73×10^{-47}. Data on the solubility of other uranyl phosphates are also included. (R.V.J.)

23515 DETERMINATION OF ZIRCONIUM HYDROXIDE DISSOLUTION RATE. P. N. Kovalenko and K. N. Bagdasarov (Rostov-on-Don State Univ., [USSR]). Zhur. Neorg. Khim., 6: 534-8(Mar. 1961). (In Russian)

The variation in zirconium concentration with pH was determined, beginning with an initial solution pH of 1.80. The $Zr(OH)_4$ activity at 19° was 1.1×10^{-54}. The influence of sodium nitrate on pH and zirconium hydroxide solubility was investigated. (R.V.J.)

23516 POLAROGRAPHIC DETERMINATION OF INDIUM HYDROXIDE DISSOLUTION. P. N. Kovalenko (Rostov-on Don State Univ. [USSR]). Zhur. Neorg. Khim., 6: 539-42(Mar. 1961). (In Russian)

The pH of initial and final precipitation from 4.59×10^{-4} mol/l solution was determined. The resulting activity of $In(OH)_3$ at 20° is 1.41×10^{-33}. (R.V.J.)

23517 AQUOFLUOOXALATOURANATES IN AQUAPENTA SUBSTITUTION SERIES. I. I. Chernyaev and R. N. Shchelokov (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 557-65(Mar. 1961). (In Russian)

The partition of oxalate groups from complex uranyl compounds by fluorine ions in aqueous solutions occurs after the formation of mixed oxalatofluorides. The following were synthesized: $Na_3[UO_2F_3(C_2O_4)(H_2O)] \cdot 2H_2O$, $Rb_3[UO_2F_3(C_2O_4)(H_2O)] \cdot H_2O$, $K_3[UO_2F_3(C_2O_4)(H_2O)] \cdot H_2O$, $Cs_3[UO_2F_3(C_2O_4)(H_2O)] \cdot H_2O$, $(CN_3H_6)_3[UO_2F(C_2O_4)_2(H_2O)] \cdot 2H_2O$, $K_3[UO_2F(C_2O_4)_2(H_2O)] \cdot 2H_2O$, and $(NH_4)_3[UO_2F(C_2O_4)_2(H_2O)]$. The complex character of separated compounds was confirmed by their molecular electro conductivity in aqueous solutions. (R.V.J.)

23518 ON HEXAVALENT URANIUM AND PENTAVALENT VANADIUM IN AMMONIUM HYDROXIDE. V. L. Zolotavin, I. Ya. Bezrukov, and Yu. I. Sannikov (Kirov Urals Polytechnic Inst. [USSR]). Zhur. Neorg. Khim., 6: 581-6(Mar. 1961). (In Russian)

The behavior of uranium and vanadium in ammonium diuranate precipitation was studied, and the composition of U(VI) and V(V) in sulfuric acid solutions during neutralization by ammonium hydroxide was analyzed. The existence of $[VO(SO_4)_2]^-$, $[VO(SO_4)_3]^{3-}$, VO^{3+}, VO_2^+, VO_3^-, and $V_2O_5^{4-}$ is postulated on the basis of light absorption in $V_2O_5-H_2SO_4(NH_4OH)-H_2O$ systems. Studies of $UO_2SO_4-NH_4OH-H_2O$ indicate the formation of $3UO_2(OH)_2 \cdot 5UO_2SO_4$, $H_2U_2O_7$, $NH_4HU_2O_7$, and $(NH_4)_2U_2O_7$. (R.V.J.)

23519 GUANIDINE THORIUM CARBONATES $(CN_3H_6)_6Th(CO_3)_5 \cdot nH_2O$. I. I. Chernyaev and A. K. Molodkin. (Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 587-92(Mar. 1961). (In Russian)

A new method of synthesizing guanidine thorium carbonates $(CN_3H_6)_6Th(CO_3)_5 \cdot nH_2O$ was developed and some properties of the compound were studied. A certain variability in structure with identical composition was observed. It is indicated that the $(CN_3H)_6Th(CO_3)_5 \cdot nH_2O$ type compound is most characteristic in thorium precipitation with saturated guanidine carbonate. (R.V.J.)

23520 COMPLEX COMPOUNDS OF THORIUM WITH MALIC ACID. O. E. Zvyagintsev and L. G. Khromenkov (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 6: 593-600(Mar. 1961). (In Russian)

Electroconductivity, pH, and potentiometric titration methods were used in studying systems of thorium nitrate-malic acid-water, thorium nitrate-sodium acid malate-water, and thorium nitrate-sodium malate-water. Two complex compounds of thorium with malic acid, with ratios of 1:1 and 1:2, were observed in various forms depending on pH. $(ThOH)_2Mal_3 \cdot 4H_2O$, $Na_2Th(OH)_2Mal_2 \cdot 4H_2O$, and $NaTh(OH)Mal_2 \cdot 6H_2O$ were separated and their structures are suggested. The instability constant of the cation complex $[ThMal]^{2+}$ was calculated. (R.V.J.)

23521 COMPLEX FORMATION OF TRIVALENT THALLIUM WITH 1.10 PHENANTHROLINE AND 2.2'-DIPYRIDYL. F. Ya. Kul'ba, Yu. A. Makashev, and V. E. Mironov (Leningrad Inst. of Tech.). Zhur. Neorg. Khim., 6: 630-5(Mar. 1961). (In Russian)

Potentiometric studies were made of Tl^{3+} complexing by 1.10 phenanthroline and 2,2' dipyridyl in nitric acid solutions at 25° and constant ionic strength $\mu = 1.0$. It is shown that the complex ions $TlPh^{3+}$, $TlPh_2^{3+}$, $TlDp^{3+}$, and $TlDp_2^{3+}$, with instability constants 2.7×10^{-12}, 0.5×10^{-18}, 4.0×10^{-19} and 0.8×10^{-16}, are formed at $[H^+] = 0.5$ and 1.0 in aqueous solutions. The instability constants of the complex ions $TlPh_2^+$ and $TlDp_2^+$ are 10^{-4} and 10^{-3}. Complex $TlAm_n^{3+}$ possesses high thermal resistance and high rates of formation and dissociation. (R.V.J.)

23522 SYNTHESIS OF CERIUM(IV) SULFATE COMPOUNDS. V. A. Golovnya and L. A. Pospelova (Kurnakov Inst. of General and Inorganic Chemistry, Academy of

Sciences, USSR). Zhur. Neorg. Khim., 6: 636-40(Mar. 1961). (In Russian)

Complex cerium trisulfates of the general formula $Me_3[Ce(SO_4)_3\ (H_2O)]$, where Me = Na^+, Rb^+, and Cs^+, were synthesized; and known cerium tetrasulfates were supplemented by new derivates: $Me_4[Ce(SO_4)_4]\cdot nH_2O$, Me = K^+, Rb^+, NH^{4+}, and Eu^{2+}. A series of the cerium(IV) sulfates was prepared: $[Ce(SO_4)_2\cdot 4H_2O]$, $[Ce(SO_4)_3\cdot (H_2O)_2]^{2-}$, $[Ce(SO_4)_4]^{4-}$, $[Ce(SO_4)_5]^{6-}$, and $[Ce(SO_4)_6]^{8-}$. Certain properties of the various complexes are analyzed. (R.V.J.)

23523 RECHARGE OF IONS ON COMPLEX MOLECULES. G. K. Lavrovskaya, M. I. Markin, and V. L. Tal'roze (Inst. of Chemical Physics, Academy of Sciences, USSR). Kinetika i Kataliz, 2: 21-37(Jan.-Feb. 1961). (In Russian)

Ion recharge on multiatomic molecules is investigated, and published data on recharge processes are analyzed. The data on recharge studies and on transitions of heavy particles are correlated. A method is suggested for classifying ion–molecule reactions. The importance of nonresonance recharge processes is discussed. (tr-auth)

23524 KINETICS OF $TiCl_3$ REACTION WITH Ti IN KCl MELT. S. F. Belov and S. I. Sklyarenko. Zhur. Neorg. Khim., 6: 754-6(Mar. 1961). (In Russian)

Titanium dispersion in the reaction $2TiCl_3 + Ti \rightleftharpoons 3TiCl_2$ is calculated using the equation $L = 1 - \exp(-Kt^n)$ (where L is the relation of reacted substance to time t, k is a constant, and n is a theoretical exponent). (R.V.J.)

Radiation Chemistry and Radiochemistry

23525 (AERE-R-3625) THE PRODUCTION OF CHEMICALS FROM REACTORS. PART V. ETHYLENE GLYCOL FROM THE PILE (n + γ) AND FISSION FRAGMENT IRRADIATION OF LIQUID METHANOL. D. A. Landsman and J. E. Butterfield (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Apr. 1961. 30p.

A series of (n + γ) radiolyses of liquid methanol at 100°C in BEPO yielded the following G-values: H_2 4.79, CO 0.30, CH_4 0.52, HCHO 2.28, and $(CH_2OH)_2$ 2.54. From a further series of experiments, in which a variety of fissile sources were immersed in the methanol, the following G-values for the fission fragment irradiation of this liquid were obtained: H_2 9.68, CO 2.98, CH 0.88, HCHO 3.6, $(CH_2OH)_2$ 0.77. The implications of these results are discussed and it is concluded that liquid phase radiolysis of methanol at 100°C with fission fragments would be an uneconomic process for the large scale manufacture of glycol. The (n + γ) radiolysis of liquid methanol may become attractive if some means could be found for increasing the yield of ethylene glycol by a factor of about three. (auth)

23526 (AFOSR-TN-60-947) IRRADIATION YIELDS OF RADICALS IN GAMMA-IRRADIATED ICE AT 4.2 AND 77°K. Seymour Siegel, John M. Flournoy, and Lillian H. Baum (Aerojet-General Corp., Azusa, Calif.). Jan. 1961. Contract AF18(603)-110. 20p. (AD-250131; TN-39)

The electron-paramagnetic-resonance (EPR) spectra of both ice and deuterated ice which were subjected to γ-irradiation at 4.2°K are presented and discussed. Experimental radical irradiation yields at 4.2°K are reported for the H_2O system as a function of sustained irradiation dosage. A comparison between the yields at 4.2 and 77°K is given, and the resulting similarities are discussed in terms of intra-spur reactions. Preliminary evidence is presented for the existence of an isotope effect for the irradiation yields. (auth)

23527 (ARL-TR-60-310) RECOIL CHEMISTRY AND RADIATION CHEMISTRY OF HIGH ENERGY TRITIUM NUCLEI IN n-PENTANE. Lloyd A. Currie (Pennsylvania State Univ., University Park). Sept. 30, 1960. Contract AF33(616)-5094. 43p. (AD-250262)

Chemical effects of high energy tritium nuclei recoiling into n-pentane molecules were investigated in order to determine the chemical fates of the tritium projectiles and the pentane target molecules. The former result in labeled molecules characteristic of hot atom (recoil) chemistry; the latter, in non-labeled degradation products characteristic of radiation chemistry (radiolysis). Analysis was performed by gas chromatographic separation followed by detection with a thermal conductivity cell and a Geiger-Müller counter. Radiolysis studies demonstrated that hydrogen and olefins were more important among the products than was previously realized. Significant enhancement of radiation decomposition was achieved by energy transfer from a surface and from an inert gas. In contrast to radiolysis products, recoil-labeled products consisted largely of hydrogen and paraffins. Detailed studies of the energy dependence of recoil labeling led to hot-collision and statistical labeling theories which give a moderately complete picture of the recoil process. A new, and remarkably efficient, method of tritium-labeling was discovered in the course of the research. (auth)

23528 (ERDE-21/R/60) THE EFFECT OF HIGH ENERGY RADIATION ON PLASTICS AND RUBBERS. PART I. POLYTETRAFLUOROETHYLENE. J. H. Golden and E. A. Hazell (Gt. Brit. Explosives Research and Development Establishment, Waltham Abbey, Essex, England). Nov. 1960. 29p. (AD-252333)

The effects of electron irradiation, in doses up to 10^9 rads, on the properties of polytetrafluoroethylene were studied. Properties which were investigated in detail include infrared absorption, tensile strength, elongation, compression moulding, and extrusion. The effects of irradiation on chemical structure are discussed. It was concluded that although the irradiated material can be processed by the conventional methods used for other thermoplastics at temperatures below its softening point the products thus obtained have negligible mechanical strength. (auth)

23529 (ERDE-26/R/60) THE EFFECT OF HIGH ENERGY RADIATION ON PLASTICS AND RUBBERS: PART 2: IRRADIATED NATURAL RUBBER–A STUDY OF METHODS FOR THE ESTIMATION OF CROSS-LINKING. J. H. Golden, E. A. Hazell, and A. L. Stokoe (Gt. Brit. Explosives Research and Development Establishment, Waltham Abbey, Essex, England). Oct. 24, 1960. 30p. (WAC/116/20; AD-250480)

Samples of natural rubber, in the form of unvulcanized, milled, smoked sheet without additives, were irradiated in vacuum over a wide range of doses in a 4-Mev electron beam. The extent of cross-linking in the specimens was investigated by methods based on determination of modulus, sol fraction, and swelling after immersion in solvents, and hydrogen evolved during irradiation. The results obtained are compared and the applicability of the methods and the mechanism of the cross-linking reaction are considered. Results obtained from irradiations in air and in vacuum are contrasted. (auth)

23530 (NAS-NS-3037) THE RADIOCHEMISTRY OF POLONIUM. P. E. Figgins (Mound Lab., Miamisburg, Ohio). Jan. 1961. 88p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

A bibliography of eight general reviews on the chemistry of Po is presented. The characteristics of Po isotopes are tabulated. The oxidation states, compounds, complexes, and analytical chemistry of Po are reviewed. Radiochemical procedures for Po are presented. (D.L.C.)

23531 (NP-10086) NUCLEAR CHEMISTRY OF SHORT-LIVED ISOTOPES. Technical Status Report No. 5, February 1, 1961–April 30, 1961. R. H. Ewart and A. W. Stoner (United States Rubber Co., Plainsboro, N. J.). June 14, 1961. Contract AF49(638)-815. 5p.

Most of the effort was devoted to a study of Er^{172} decay. The tentative decay scheme was examined and correlated with experimental data. A diagram of the scheme is included. In other work, the conversion electron lines of the 27-, 54-, and 82-kev Dy^{166} transitions were measured. (J.R.D.)

23532 (SRO-51) RADIATION-INDUCED CYANOGENATION OF ORGANIC COMPOUNDS. ANNUAL TECHNICAL STATUS REPORT NO. 1, COVERING PERIOD MAY 1, 1960 TO MARCH 31, 1961. James A. Knight, Jr. and Coleman J. Bryan (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Apr. 10, 1961. Contract AT(38-1)-202. 35p.

Studies were made of the effects of ionizing radiation on the cyanogenation of organic compounds, in which emphasis was placed on: the irradiation of cyanogen-organic mixtures; and the analysis of the irradiated mixtures for cyano products and for unconsumed cyanogen. The organic compounds that were irradiated in admixture with cyanogen are benzene, toluene, n-heptane, cyclohexane, 2,4,4-trimethylpentene-1, 2,2,4-trimethylpentane, 2-methylpentane, and 3-methylhexane. Infrared analysis of the irradiated mixtures indicated that radiation-induced cyanogenation occurred with all of the above organic compounds. In two experiments at room temperature in the absence of ionizing radiation, cyanogenation did not occur. Irradiations were conducted in both sealed-glass irradiation tubes and a stainless steel bomb. All irradiations were carried out in the 12-kilocurie Cesium-137 Research Irradiator. An acceptable quantitative method was developed for the determination of cyanogen dissolved in an organic compound. The solubilities of cyanogen were determined in each of the hydrocarbons studied. (auth)

23533 (TID-7610) NUCLEAR REACTOR CHEMISTRY. FIRST CONFERENCE, GATLINBURG, TENNESSEE, OCTOBER 12 THROUGH 14, 1960. (Oak Ridge National Lab., Tenn.). 163p.

Eight papers and thirty abstracts of papers presented at the First Conference on Nuclear Reactor Chemistry are given. Topics discussed include behavior of fission products in reactor materials, corrosion processes in reactor materials, effects of radiation on reactor materials, and chemical behavior of fuel and blanket systems. Seven papers are covered by separate abstracts. One paper was previously abstracted for NSA. (M.C.G.)

23534 (TID-13166) THE DILUTE SOLUTION CHEMISTRY OF ANTIMONY (thesis). Kent H. Jones (New Mexico. Univ., Albuquerque). 1960. 96p.

Dilute solutions (10^{-9} to 10^{-10} M) of carrier-free Sb^{125} in HCl, H_2SO_4, $HClO_4$, and water were prepared from neutron-irradiated Sn and the chemical behavior of Sb^{125} in these solutions studied. The studies covered the stability and redox behavior of Sb^{125}(III) and Sb^{125}(V) under various conditions, the extent of adsorption and coprecipitation of Sb^{125} from different solutions and with different substances, and the relationship between the behavior of carrier-free Sb^{125} and that of conventional concentrations ($\geq 10^{-5}$ M) of Sb. (D.L.C.)

23535 (UCLA-479) MECHANISM FOR THE TRANSFORMATION OF FERRIPROTOPORPHYRIN BY A Co^{60}-γ-RAY INITIATED CHAIN REACTION. Mary-Louise Rothschild (California. Univ., Los Angeles. School of Medicine). June 23, 1961. Contract AT-04-1-GEN-12. 27p.

The mechanism for the Co^{60} γ-radiation initiated transformation of ferriprotoporphyrin in 0.1 N NaOH to another ferriporphyrin compound was examined by studying the effect of ferriprotoporphyrin concentration, hydrogen peroxide concentration, dose, and dose rate on the yield. The data establish that ferriprotoporphyrin is transformed by a dose rate independent chain reaction initiated by hydrogen peroxide and possibly other products of the radiolysis of water. Initial yields as high as 220 μM/l/1000 r were found. To explain the experimental results it is postulated that in alkaline solution ferriprotoporphyrin exists in an equilibrium between a monomeric form and a dimeric form. Several mechanisms are proposed, each of which satisfies the conditions that the average chain length is proportional to the concentration of the monomeric form and that all chains are initiated, propagate, and terminate independently of one another. (auth)

23536 (NP-tr-628) CHEMICAL INDUSTRY (SELECTED ARTICLES). Translated from Khim. Prom., No. 8, 647-52; 672-4; 721-38(1959).

Included are two papers discussing basic technological characteristics of apparatus for conducting radiochemical processes, particularly for polymerizing ethylene, on an industrial scale, and the production of foamy polystyrene with saturated low-boiling hydrocarbons. Indices are given of articles published during 1959 in Khimicheskaya Promyshlennost', as well as for authors and subject matter. A separate abstract was prepared for the first paper. (B.O.G.)

23537 (NP-tr-628(p.1-15)) BASIC TECHNOLOGICAL CHARACTERISTICS OF APPARATA FOR CONDUCTING RADIO-CHEMICAL PROCESSES (IN PARTICULAR FOR POLYMERIZATION OF ETHYLENE) OF AN INDUSTRIAL SCALE. N. P. Syrkus, A. Kh. Breger, and B. I. Vainshtein (Vaynshteyn). Translated from Khim. Prom., No. 8, 647-52(1959).

A description is given of the use of a spherical unit to provide a general analysis of the individual and most important technological characteristics of radiochemical apparatus. The evaluation method involves a comparison with the output of an apparatus of infinite size having an identical source. It was shown that the power efficiency does not in general constitute a single-valued criterion for evaluating the efficiency of radiochemical apparatus. A calculation was performed of the technological characteristics of an apparatus for the polymerization of ethylene at 200 atm and 25°, with a rod-type Co^{60} γ-source. It was shown that apparatus for the polymerization of ethylene may be calculated on the basis of average dose rate values. The output of the apparatus was shown to be a power of the γ-ray power, of the source, provided all other conditions are equal. (B.O.G.)

23538 (NP-tr-683) SELECTIVITY AND TYPICAL REACTION MECHANISMS IN RADIATION CHEMISTRY.

G. O. Schenck. Translated by R. Hardbottle (U.K.A.E.A., Atomic Energy Research Establishment) from Z. Elektrochemie, 64: 997-1011(1960). 72p. (Includes original, 11p.). (Handwritten MS)

The selectivity of radiation-chemistry reaction systems was found to be due to the physical selection of the radio-induced initiation and to the chemical selection of the ensuing processes, and is greatly affected by changes in the composition of the reaction systems. Methods of distinguishing between the reactors which take place through radical intermediate materials and the after-reactions are considered. The main types of radiation-chemistry reaction mechanisms were found to be goverened by the occurrence of acyclic or cyclic reactions and by the nature of the radical intermediates. The part played by chemical selection in these reactions is outlined. The discussion is limited to changes in homogeneous liquid systems. A comparison was made of the chemical effects of optical and ionizing radiations on the same system of materials. Examples are given to show how reaction mechanisms can be misinterpreted as a result of unrecognized after-reactions and to show to what extent the selectivity of radio-induced reaction systems can be changed by small amounts of materials acting as catalysts in the reaction sequences. (M.C.G.)

23539 (NP-tr-695) RADIATION INITIATION OF CHAIN BRANCHED REACTIONS AND ITS SENSITIZATION. E. V. Barelko, L. I. Kartashova, P. N. Komarov, and M. A. Proskurnin. Translated by R. W. Hummel for U.K.A.E.A., Atomic Energy Research Establishment from p.407-21 of "Large Radiation Sources in Industry. Vol. 1. Conference Proceedings, Warsaw, 8-12 September 1959." A publication of International Atomic Energy Agency, Vienna, 1960. 22p.

Principal results of an investigation of radiation-initiated chain branched oxidation of organic substances are presented. The role of radiation as an initiating agent was demonstrated by a number of examples. Kinetic curves for the oxidation of n-hexadecane initiated by various doses of gamma radiation are given. The oxidation of benzene, which has an increased stability to radiation, was carried out in the presence of a substance unstable to radiation which on irradiation gives rise to highly active atoms and free radicals. It was found that growth of the autoaccelerated process occurs in which the radiation may be merely the initiator, and which occurs after the cessation of radiation. Fundamental quantities characteristic of the radiolytic oxidation of benzene are given: kinetic curves for the accumulation of various products; the dependence of the shape of these curves on temperature, pressure, dose rate, and total dose; and conclusions about the mechanism of the process. It is shown that a circulating system is most efficient. The design of such an apparatus is described. (M.C.G.)

23540 A COMPARISON OF ALUMINIUM FOR REACTOR MATERIALS BY ACTIVATION METHOD. Hiedo Yamaki (Hitachi Ltd., Japan). J. At. Energy Soc. Japan, 3: 323-8(May 1961). (In Japanese)

The neutron absorption cross sections and the induced radioactivities of some samples of 2 S and 52 S aluminum are determined by the activation method. For the cross sections, no significant difference is observed between samples. The values for the 2 S and 52 S samples are 1.43×10^{-2} cm^{-1} and 1.39×10^{-2} cm^{-1}, respectively. There are some differences in short life activities among the samples. The maximum activities are roughly 10 times that of the minimum, but after 10 hr from the end of irradiation, the maximum values come down to double the minimum. These differences result from the different contents of Cu, Mn, Ga, and Zn in each sample. In this test, integrated neutron fluxes are 2.39×10^{15} n/cm^2 and 1.31×10^{16} n/cm^2. The gamma-ray spectrum and its time dependence were measured for each sample by a 256-channel pulse height analyzer. (auth)

23541 THE GAMMA-RAY SPECTROMETRY OF FISSION PRODUCTS. IV. A NEWLY DEVICED METHOD OF GAMMA-RAY SPECTROMETRIC ANALYSIS OF FISSION PRODUCT MIXTURES. Ichiro Mattori (Ishikawajima-Harima Heavy Ind. Co., Ltd., Japan). J. At. Energy Soc. Japan, 3: 338-43(May 1961). (In Japanese)

A gamma spectrometric method is described for analyzing fission product mixtures. The process consists of three parts. First, the gamma spectra are compared with standard spectra, which are predicted by observation of known fission products, in order to find the age of the sample. Tables of relative abundances of fission products as functions of age are then used to determine the composition of the sample. Finally, the absolute activities of individual radionuclides are calculated from the measured counting rate of the sample. (auth)

23542 REACTOR-IRRADIATED PHOSPHORYL CHLORIDE. T. J. Clark and H. C. Moser (Kansas State Univ. of Agriculture and Applied Science, Manhattan). J. Inorg. & Nuclear Chem., 17: 210-14(June 1961). (In English)

Samples of $POCl_3$ were reactor irradiated for varying periods of time in a thermal neutron flux of approximately 6×10^{11} n cm^{-2} sec^{-1}. The irradiated samples were examined by carrier distillation techniques which showed the presence of $P^{32}Cl_3$, $P^{32}OCl_3$, and a labeled high-boiling component. A changing distribution of P^{32} in the products was observed. The percentage of total P^{32} found in combination as $P^{32}Cl_3$ decreased from about 60% to less than 10% with increasing irradiation time while that found as $P^{32}OCl_3$ increased from about 30% to greater than 80%. Phosphorus exchange in the system PCl_3–$P^{32}OCl_3$ was investigated and appeared to be negligible for the distillation conditions used in this study. (auth)

23543 CROSSLINKING OF CELLULOSICS BY HIGH ENERGY RADIATION. [PART] II. Frederick C. Leavitt (Dow Chemical Co., Framingham, Mass.). J. Polymer Sci., 51: 349-57(May 1961).

Nonionic water-soluble cellulose ethers were crosslinked by irradiation with high energy electrons in aqueous solution. The unexpected behavior of cellulosics toward radiation is reproducible. Crosslinking and chain scission are competitive reactions; nevertheless, conditions are described for obtaining one or the other as the predominant reaction. It is proposed that the mechanism is free radical in nature. High beta radiation dose rates (Van de Graaff generator) are necessary to crosslink substantial amounts of polymer. Low dose rates fail to yield crosslinked products. Degradation, oxidation, and cleavage of substituent groups occur over a wide range of radiation dose rates. The viscosity of the medium also plays a major role in determining whether crosslinking will take place. Highly viscous solutions with limited freedom of chain motion are degraded until the viscosity is sufficiently low to allow free bimolecular coupling reactions; then a gelled system forms immediately. Carboxylated cellulosics were not crosslinked by this method. Samples examined were degraded at all levels of radiation. The crosslinked cellulose derivatives included methyl cellulose, hydroxyethyl cellulose, methyl hydroxypropyl cellulose, and methyl hydroxybutyl cellulose. (auth)

23544 GAMMA-RAY-INDUCED GRAFT COPOLYMERIZATION OF STYRENE ONTO CELLULOSE AND SOME CHEMICAL PROPERTIES OF THE GRAFTED POLYMER. Y. Kobayashi (Toyo Spinning Co., Ltd., Katada-cho, Japan). J. Polymer Sci., 51: 359-72(May 1961).

The graft copolymerization of cellulose and styrene was accelerated by immersing the cellulose in H_2O_2 solution during γ irradiation. The number of active sites such as hydroperoxides was estimated by the ferrous ion method. A correlation between the number of active sites and the rate of grafting is shown. The acetylation of the grafted cellulose–styrene polymer was carried out. The progress of the reaction was observed from the weight increase and infrared spectra measurement. The reaction proceeded very rapidly owing to the increased swelling of grafted polymer in the treating bath. The acetylation of the cellulose–styrene polymer was next carried out under more severe conditions. The cellulose part of the grafted polymer was degraded by acetolysis and only the polystyrene was extracted from the grafted polymer. The viscosity-average molecular weight of the extracted polystyrene was estimated by viscometry and the degree of polymerization was calculated as 1.98×10^6. The value was compared with the number of the active sites estimated by the ferrous ion method. (auth)

23545 EFFECTS OF IONIZING RADIATION UPON SOLUTIONS OF SYNTHETIC AND BIOLOGICAL POLYMERS. II. EXTENSION OF MOLECULE AND CHEMICAL PROTECTION. Shintaro Sugai and Kazuo Kamashima (Hokkaido Univ., Sapporo). Kobunshi Kagaku, 18: No. 192, 191-7(1961). (In Japanese)

The protective effects of salts and alcohols against γ-ray denaturation in aqueous solutions of polyelectrolytes are studied in solutions of sodium salts of carboxymethyl cellulose and DNA. In solutions including a small quantity of salt the protection effects are likely due to the molecular contractions, but in solutions including a large quantity of salts the effects seem to be due to the scavenging effects of ions. However, the protection effects produced by adding alcohols are never due to molecular contraction. The quantitative considerations in these cases are given. (auth)

23546 PRODUCTION OF THE RADIOACTIVE ISOTOPES IN THE INSTITUTE "BORIS KIDRIČ," VINČA. Zdenko Dizdar (Institut za Nuklearne Nauke "Boris Kidrič," Vinča, Yugoslavia). Nova Proizvodnja, 11: 228-35(1960). (In Yugoslavian)

Yugoslavia will start producing sulfur-35, iodine-131, phosphorus-32, gold-198, iridium-193, and cobalt-60 in 1961 with their new 16 Mev cyclotron at Zagreb and their new reactor with the rated output of 6.5 Mev at Vinca. The reactor is composed of 43 vertical radiation channels having diameters of 50, 100, and 110 mm. The medium flux is 10^{13} n/cm^2 sec. A new radiation laboratory being built will permit more isotope production. Radiation limitations are also discussed for the reactor. (N.W.R.)

23547 PRODUCTION OF THE MODIFIED STARCHES FOR THE PAPER AND TEXTILE INDUSTRY BY MEANS OF THE GAMMA RAYS. Maks Samec (Kemijski Inštitut "Boris Kidrič," Ljubljana, Yugoslavia). Nova Proizvodnja, 11: 277-9(1960). (In Yugoslavian)

A method of producing a soluble starch from potato starch by means of gamma radiation and without water, heat, or chemical agents is described. This soluble starch is comparable to modified starches produced in industry. By increasing the gamma dosage, 60% of the starch may be converted into dextrins. (N.W.R.)

23548 NUCLEAR CHEMICAL INVESTIGATIONS OF ALPHA-RADIOACTIVE NEUTRON-DEFICIENT NUCLIDES PRODUCED BY HEAVY ION REACTIONS. Wilhelm Forsling (Nobel Inst. of Physics, Stockholm and Univ. of Stockholm). Svensk Kem. Tidskr., 73: 210-32(1961). (In English)

A research group studied neutron-deficient nuclides in the heavy element region. The nuclides were produced by reactions induced by cyclotron-accelerated heavy ions. The present work deals mainly with the nuclear chemistry problems involved in the program. A general survey of the problems involved is given followed by a survey of 10 different papers which deal with the subjects: the use of heavy ions in nuclear science; acceleration and bombarding techniques, preparation of targets, separation and preparation of reaction products, measurements of radioactive properties, products of heavy ion nuclear reactions, polonium isotopes, astatine isotopes, alpha radioactivities in the region Z = 80 to 83, and nuclides among the heaviest elements. (P.C.H.)

23549 PHOTOLYSIS OF HYDROGEN PEROXIDE AT HIGH LIGHT INTENSITIES IN AQUEOUS SOLUTIONS ENRICHED IN O^{18}. M. Anbar (Weizmann Inst. of Science, Rehovoth, Israel). Trans. Faraday Soc., 57: 971-82(June 1961).

The photolysis of $H_2O_2^{16,16}$ was carried out in water highly enriched in O^{18} at high light intensities (10^{-2} einst. $l.^{-1}$ min^{-1}). $H_2O_2^{16,18}$ $O_2^{16,16}$ and $O_2^{16,18}$ were formed. Hydrogen peroxide, bromide, and nitrite ions decreased the yield of $H_2O_2^{16,18}$. Cu^{2+} increased both the yield of $H_2O_2^{16,18}$ and of $O_2^{16,18}$. Experiments using $H_2O^{16,16} + H_2O^{18,18}$ showed considerable scrambling in the evolved O_2. The photochemically-induced exchange of H_2O_2 with O_2 was also investigated. The results are compared to the tracer behavior of radiolyzed $H_2O_2^{16,16}$ solutions in H_2O^{18}; it is found that the products are formed by different mechanisms in the two systems. The suffested mechanism involves the formation of O radicals in the ^{1}D state: $H_2O_2 \rightleftharpoons O + H_2O$ and the formation of oxygen by $O + H_2O_2 \rightarrow O_2 + H_2O$. In a secondary reaction $O^{18}H$ radicals are formed: $O^{16} + H_2O^{18} \rightarrow O^{16}H + HO^{18}$. The interaction of $O^{18}H$ with O^{16} or with $H_2O_2^{16,16}$ will produce $HO_2^{16,18}$ and consequently $O_2^{16,18}$. The dissociation of H_2O_2 to two OH radicals, or perhaps the formation of oxygen atoms in the ^{3}P state in parallel photolytic processes, is postulated to account for differences between the quantum yield of total photolytic decomposition and the yields of scrambled and exchanged products. (auth)

23550 CHEMICAL EFFECTS OF RADIATIVE THERMAL NEUTRON CAPTURE. PART 8. RETENTION IN SOLID SOLUTIONS OF CHROMATES. A. G. Maddock and J. I. Vargas (University Chemical Lab., Cambridge, Eng.). Trans. Faraday Soc., 57: 992-8(June 1961).

The initial retention, the limiting retention after thermal annealing, and the susceptibility to radiation annealing, of thermal neutron-irradiated solid solutions of potassium chromate in potassium fluoberyllate were shown to be linear functions of the composition of the mixed crystals. Such a relation is found to be incompatible with the activated exchange model for the radiation annealing process. The susceptibilities of a number of chromates and dichromates to thermal and radiation annealing were determined and the behavior of ammonium dichromate and anhydrous lithium chromate studied in more detail. No evidence of the epithermal reaction of the fragments with ammonium ions was obtained. Some futher data on mixed crystals of chromates and sulfates are reported. (auth)

23551 RADIATION-INITIATED POLYMERIZATION AND GRAFT POLYMERIZATION. R. Roberts (Interna-

tional Atomic Energy Agency, Vienna). Review Series No. 13. Developments in the Peaceful Applications of Nuclear Energy. 1961. 43p. (STI/PUB/15/13)

The mechanisms of polymerization initiated with high energy radiation are considered. In particular a comparison is made of the ionic processes which occur at low temperature with the free radical mechanisms which are usual when the polymerizations are carried out at room temperature and above. The kinetics of radiation-initiated polymerization are compared with those obtained when polymerization is initiated by light and chemical catalysts such as peroxides. Polymerization in the solid state and in solution is described, with particular reference to the different physical properties obtained using radiation as compared with those obtained using conventional initiators. The polymerization of unsaturated esters is discussed. The various methods for production of non-random co-polymers are considered, in particular the techniques of polymer-monomer irradiation and initial peroxide formation. The kinetics are also considered. A survey is made of the technological advantages to be obtained by the use of non-random co-polymers in such fields as the modification of the properties of synthetic fibers, emulsion systems, cross-linking of polymers, production of ion-exchange membranes, and improvements in the temperature resistance of polymers. (auth)

23552 POLYMER COMPOSITIONS AND METHOD FOR PRODUCING THE SAME. (to Houilleres du Basin du Nord et du Pas-de-Calais and Ethylene-Plastique S. A.). British Patent 870,650. June 14, 1961.

A method of forming a compatible mixture of at least two normally incompatible polymers selected, respectively, from a first class comprising the polyolefins and a second class comprising the polymers obtained by the radical polymerization of monomers containing at least one vinyl group is described. The method consists of first preparing at least one graft copolymer from a polymer of the first class and a monomer which on polymerization gives a polymer of the second class. The graft copolymer is mixed at 125 to 200°C with from two to twenty times the weight of the graft copolymers of a mixture of the polymers to be made compatible. A portion of the first class of polymers is preliminarily activated by irradiation. As an example, some of the first class polymers are polyethylene, polypropylene, polyisobutylene, and the like. Polystyrene, polyvinyl acetate, polyvinyl chloride, polyacrylonitrile, polyallyl chloride, polybutadiene, and the like make up the second class. (N.W.R.)

23553 IMPROVEMENTS IN OR RELATING TO METHODS OF LABELLING AND IDENTIFYING MATERIALS. Douglas Brian Smith (to United Kingdom Atomic Energy Authority). British Patent 872,154. July 5, 1961.

A method of labeling and identifying materials which have a given thermal neutron absorption cross section is described. The method consists of incorporating in the material a substance having a higher thermal neutron absorption cross section and detecting the change in attenuation of a thermal neutron flux in passing through the labeled sample as compared with the attenuation in passing through the same material containing either none or a different proportion of the substance. The material may be steel and the incorporated substance boron. (N.W.R.)

23554 MODIFIED SYNTHETIC CONDENSATION POLYMERS AND THEIR PRODUCTION. (to E. I. Du Pont de Nemours and Co.). British Patent 872,513. July 12, 1961.

Description is given of a process for the production of a grafted polymer in which the substrate is a synthetic condensation polymer and the grafted structures contain acid groups or acid salt groups other than carboxyl or carboxylate salts groups and are derived from monomers containing reactive nonaromatic carbon-carbon unsaturation and groups corresponding to or convertible to the acid groups or acid salt groups. The grafted structure is a styrene sulfonic acid containing calcium, sodium, or potassium salt group. The synthetic condensation polymer is a polyamide. The grafting is accomplished by irradiating the solid substrate in contact with the monomer with high energy particulate or electromagnetic ionizing radiation. The substrate is maintained below 0°C until the grafting is completed. (N.W.R.)

Raw Materials and Feed Materials

23555 (CEA-1882) LES RECENTS PROGRES TECHNIQUES DANS L'INDUSTRIE DE L'URANIUM EN FRANCE. (Recent Technical Progress in the French Uranium Industry). H. Huet (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 13p.

Presented at the 32nd International Congress on Industrial Chemistry, Barcelona, October 1960.

The present-day uranium production situation in France is reviewed. The various stages of the treatment that the concentrates receive, leading to the final production of the metal, are described briefly: dissolution; purification by extraction with a mixture of tributyl phosphate and white spirit; precipitation with ammonia; drying and calcination of the trioxide; reduction with hydrogen, cracked ammonia, or preferably pure ammonia gas; fluorination with anhydrous hydrofluoric acid; and production of the metal by the calcium thermite process. Recent work of an original nature is discussed in greater detail. (auth)

23556 (CEA-1884) LA NOUVELLE USINE FRANCAISE DE RAFFINAGE D'URANIUM DE NARBONNE. (The New French Uranium Refining Plant at Narbonne). J. Roux (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 13p.

Presented at the 32nd International Congress on Industrial Chemistry, Barcelona, October 1960.

In 1957 the Commissariat à l'Energie Atomique, in collaboration with two French industrial firms, undertook the construction of a plant for the production of refined uranium on an industrial scale. This plant, which forms part of the French nuclear equipment program and which works at a capacity of 1,000 tons/year, was put into operation in July 1959. The principles on which this undertaking is based are outlined. This is followed by a more detailed account of the construction, including the improvements brought to the process developed at the C.E.A. plant at le Bouchet when it was carried over to the industrial stage by the uranium branch of the Société d'Etudes et de Travaux. (auth)

23557 (HW-SA-2212) AUTOMATION OF A CONTINUOUS CALCINER. R. Y. Lyon and N. P. Wilburn (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 12, 1961. 13p.

The hardware and methods required to automate a continuous calciner used in making UO_3 powder from uranyl nitrate hexahydrate are described. (auth)

23558 (NP-10358) MONTHLY PROGRESS REPORT [ON REFINING] DEVELOPMENT, MAY 1960. (Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa). 14p.

Results of atmospheric carbonate leach tests on feed prepared from mill head samples are summarized. Caustic precipitation of sodium diuranate from carbonate leach solution is described. An electrolytic process to regenerate H_2SO_4 and NaOH from by-product Na_2SO_4 is being studied. A solvent that is predominantly straight chain paraffin was tested for nitration resistance. A sample of ADU chemical precipitate was calcined at 850°C, ground, blended, ground ferrosilicon added during the blending, and pressed to produce sound pellets with a maximum density of 3.75 gm/cm^3. The reduction of UO_2 with 1.5 times the theoretical excess of magnesium at 650°C under argon produced a pyrophoric powder which could be stabilized under argon by soaking the powder with a 10% solution of paraffin wax in CCl_4, and then evaporating the CCl_4. Reduction of U_3O_8 was carried out with aluminum to check the the recovery of the aluminum and uranium. Metallurgical examinations of U_3Si produced by melting silicon and uranium at temperatures between 1725 and 1825°C revealed several phases and carbide formation. UO_2 fusions in tungsten crucibles failed because the tungsten melted at approximately the same temperature as the UO_2. A rapid method for the determination of water soluble chloride was developed. (M.C.G.)

23559 KINETICS OF THE HYDROFLUORINATION OF URANIUM DIOXIDE. L. Tomlinson, Sheila A. Morrow, and S. Graves (United Kingdom Atomic Energy Authority, Salwick, Lancs, Eng.). Trans. Faraday Soc., 57: 1008-18 (June 1961).

The kinetics of the reaction of uranium dioxide with gaseous hydrogen fluoride were investigated in the temperature range 200 to 450°C. The amount converted in a given time (at 450°C) increased as the dioxide surface area was increased from 0·15 to 2·1 m^2/g. Above this value it was generally unaffected by surface-area changes. The initial rate of reaction was very rapid and accompanied by particle overheating and a decrease in surface area. The reaction rate during the later (isothermal) stage of the reaction was directly proportional to the hydrogen fluoride partial pressure and had an activation energy of 9·6 kcal/mole. Possible mechanisms for this complex gas-solid reaction are discussed and evaluated. (auth)

23560 A PROCESS FOR OBTAINING URANIUM DIOXIDE. (to Junta de Energia Nuclear). British Patent 870,116. June 14, 1961.

Uranium dioxide is formed by heating ammonium diuranate to 800 to 900°C in a container. The gases evolved during the heating process act on the residual oxide formed during the heating to form uranium dioxide. A set-up of the equipment is presented. (N.W.R.)

23561 IMPROVEMENTS IN OR RELATING TO PROCESS FOR MAKING URANIUM HEXAFLUORIDE. (to Hercules Powder Co.). British Patent 871,061. June 21, 1961.

A process for the manufacture of uranium(VI) fluoride from ore concentrates wherein the valence state of the uranium is from four to six is described. The process consists of comminuting and classifying the ore concentrate to a particle size satisfactory for fluidizing. The ore concentrate is converted to UF_6 by contacting with an F_2-containing gas in at least two stages; the fluorination in the first stage is controlled in order that a nonvolatile uranium composition is produced substantially free of UF_6. The contact temperature in the first stage for reacting the uranium ore concentrate with fluorine is below 300°C. The contact temperature-time conditions in the last stage are effective to substantially complete the conversion of the uranium compounds contained in the ore concentrate to UF_6. The contacting in each stage is carried out by passing the F_2-containing gas upward through the ore concentrate with a gas velocity sufficient to fluidize body. The UF_6 is condensed from the off-gas streams of the fluorination stages and is purified by distillation. (N.W.R.)

Separation Processes

23562 (AERE-R-2949) THE USE OF MOLTEN CALCIUM IN THE PROCESSING OF METALLIC FAST REACTOR FUELS. APPENDIX 1: THE DETERMINATION OF TANTALUM, LANTHANUM AND BARIUM IN URANIUM BY TRACER TECHNIQUE AND γ SPECTROSCOPY. I. L. Jenkins, N. J. Keen, D. Lawson, and J. L. Woodhead (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). 1960. 27p.

The behavior of Pu, U, and some fission products in a system where Pu–U alloy is melted with Ca was examined. Pu, U, and the noble fission products remained in the fuel alloy phase; the rare earth and the alkaline earth metals were extracted into the Ca. It is concluded that a process based on the use of molten Ca is feasible for the processing of metallic fuels from fast reactors provided that the melting point of the fuel is considerably less than 1000°C. The processing of metallic reactor fuels by molten Ca did not compare favorably with oxide slagging. Tracer technique and gamma spectroscopy methods for the determination of Ta, La, and Ba in U are presented. (auth)

23563 (CNEN-51) THE EXTRACTION OF ACIDS BY LONG CHAIN TERTIARY AMINES. G. Scibona and M. Ziffereno (Italy. Comitato Nazionale per L'Energia Nucleare, [Ispra]). Jan. 1961. 25p.

Nitric acid extracts in benzene solutions of long chain tertiary aliphatic amines to an extent that is greatly in excess of the acid required for salt formation. The excess acid is due partly to the extractive properties of the benzene itself and partly to the properties of the amine mononitrate solution. For the portion of acid extracted by the amine salt a partition coefficient is introduced that is a linear function of the amine concentration. Simple equations are given which allow the computation of the amount of HNO_3 extracted into the organic phase in a wide range of HNO_3 concentration (0-16M) and amine concentration (0.05-1M). Trilaurylamine and tri-n-octylamine were used in the investigation. Scouting experiments were also conducted with hydrochloric and sulfuric acids. (auth)

23564 (DP-587) COMPOSITION AND STABILITY OF "ULTRASENE". David L. West (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). June 1961. Contract AT(07-2)-1. 14p.

"Ultrasene" typically contained 57 wt % branched-paraffins and cycloparaffins, 40 wt % n-paraffins, 3 wt % aromatics, and less than 0.1 wt % olefins. The n-paraffinic fraction from "Ultrasene" was stable to chemical and radiolytic degradation, whereas the combined branched paraffinic and cycloparaffinic fraction, and the aromatic fraction, were significantly less stable. (auth)

23565 (HW-68003(Rev.)) SELECTIVE REDUCTION OF PLUTONIUM(VI) TO PLUTONIUM(IV) IN A PLUTONIUM(IV-VI) NITRIC ACID SOLUTION. M. H. Campbell (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1961. Contract AT(45-1)-1350. 14p.

The technique for adjusting the valence of Pu in the Pu(IV-VI) system to the Pu(IV) state for efficient solvent extraction or anion exchange is described. Investigations

show that Pu(VI) may be reliably reduced to Pu(IV) with ferrous sulfamates. Nitric acid concentration must be between 2 and 6 M to avoid Pu disproportionation of sulfamate precipitation. Ferrous sulfamate concentration is kept below 1 M to prevent crystal formation after the reaction, but Pu concentration may be as high as 250 g/l. (P.C.H.)

23566 (IDO-14321) THE NITRIC ACID DISSOLUTION OF URANIUM–ALUMINUM ALLOY IN A FLOODED CONTINUOUS DISSOLVER. A. F. Boeglin, J. A. Buckham, L. Chajson, R. B. Lemon, D. M. Paige, and C. E. Stoops (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). [1954]. Decl. Feb. 3, 1961. Contract AT(10-1)-205. 93p.

Extensive pilot plant studies of the mercury-catalyzed nitric acid dissolution of unirradiated 7.5% uranium–92.5% aluminum alloy slugs were carried out in tall-pipe, flooded, continuous dissolvers. In producing an acidic product containing 1.2M aluminum nitrate, dissolution rates as high as 15 kg of aluminum per day per square inch of cross section were achieved. Countercurrent flow of metal and acid has some advantages over concurrent flow. The large heat of reaction produced great volumes of steam in the dissolvers; the operational problems due to the resulting foam were best solved by the use of an over head reflux condenser to condense, partially or totally, the steam in the off-gas. Only minor quantities of solids were found in acidic product solutions. Extruded alloy dissolved about twice as fast as cast alloy. The metal dissolving rate was directly proportional to the 0.8 power of the nitric acid feed rate and to the cube root of the mercuric ion (catalyst) concentration. The maximum dissolving rates occurred at feed acid concentrations of about 3M for cast slugs and 5M for extruded alloy. The system studied is inherently self-regulating in that a uniform product composition will normally be produced by feeding slugs, nitric acid, and catalyst at constant rates. The occasional minor rate adjustments are best accomplished by varying the catalyst concentration. Data and correlations developed are given. (auth)

23567 (NAS-NS-3102) SEPARATIONS BY SOLVENT EXTRACTION WITH TRI-n-OCTYL-PHOSPHINE OXIDE. J. C. White and W. J. Ross (Oak Ridge National Lab.). Feb. 8, 1961. 60p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

A compilation was made of extraction data obtained for tri-n-octylphosphine oxide (TOPO). Diluents, oxidation states of the elements, type and concentration of acid, concentration of the metal and extractant, phase volumes, temperature, phase equilibrium, stripping, decomposition of metal adducts, and determination of extracted elements are discussed. Its extraction characteristics for the elements in each periodic group are described. (M.C.G.)

23568 (NAS-NS-3103) LOW-LEVEL RADIOCHEMICAL SEPARATIONS. T. T. Sugihara (Clark Univ., Worchester, Mass. Jeppson Lab. of Chemistry). Apr. 1961. Contract AT(30-1)-1930. 38p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

The general aspects of low-level radiochemical separations are discussed and some specific procedures are outlined. Blank determinations, reduction of blank correction, identifying nuclides in low-level determinations, relationships between ordinary and low-level procedures, general rules for design of a low-level procedure, and several examples of low-level procedures are described. One hundred and twenty-one references are included (M.C.G.)

23569 (NLCO-785(Del.)) SUMMARY TECHNICAL REPORT FOR THE PERIOD JANUARY 1, 1959 TO MARCH 31, 1959. John W. Simmons, ed. (National Lead Co. of Ohio. Cincinnati). Apr. 15, 1959. Decl. with deletions Apr. 20, 1960. Contract AT(30-1)-1156. 144p.

It was found that Vitro concentrates can be processed in normal Refinery feed blends when a "hot concentrated" digestion procedure is utilized. Revised impurity tolerance limits for FMPC feed materials were prepared. Using nitrate salts plus a minimum of nitric acid in the aqueous phase during laboratory equilibrium tests resulted in a greater percentage of uranium being found in the TBP–kerosene extractant than when comparable quantities of nitric acid alone were used. The amount of dissolved sodium nitrate transferred from the aqueous phase to the organic phase during these tests was found to be directly related to the amount of TBP–H_2O complex in the organic phase. A density-measurement system in a refinery extraction column detected changes in the uranium profile much more quickly than instruments then in use. Weekly samples of solvent from the refinery were examined to determine the current solvent condition. Coalescence time measurements, solvent re-extractability, and infrared spectral analysis were found to be valid indicators of this condition. Batch shakeouts of bauxite-treated solvent quickly nullified the benefits of the bauxite treatment. It was postulated that contact of the solvent with water may cause formation of the TBP–H_2O complex, increasing solvent coalescence time. A method of controlling the residual volatiles content in the plant denitration cycle was expected to improve the uniformity of the product orange oxide. A method was developed to measure the surface area of UO_2 samples without exposing them to air. Sodium decontamination of uranyl nitrate solution was effected by use of the ADU process. The structure and mode of thermal decontamination of compounds formed in the ADU process are postulated. An amine extraction flowsheet for purification of MgF_2-type scrap sufficiently for precipitation of metal grade UF_4 was developed. Small-scale bomb reduction equipment was used in investigating the reduction-to-metal step. Magnesium excess had the greatest effect on the crude yield. Factors representing the uranium content of three grades of uranium derbies were obtained. The derby grades were established on the basis of the amount of exterior slag on each derby. Melting the charge by use of the plant cycle and casting into a heated mold resulted in the following: increase in the slug-to-good-slug yield, reduction of carbon and nitrogen levels, and increase in the process yield. Uranium ingots having 8½- and 13½-inch diameters were formed by arc-melting electrodes fabricated from smaller diameter ingots. In a metallographic investigation of beta heat treated uranium metal, the way the metal deforms and the effect of deformation on the physical properties of the metal were studied. Cutting shear strength, coefficient of friction, and shear angle were determined by determining tool forces by use of a dynamometer. Metal grade UF_4 was produced on pilot plant scale by precipitation of a black oxide leach liquor with 52% HF, SO_2 reducing agent, and a copper salt catalyst. Hydrated UF_4 was simultaneously dehydrated and blended with UF_6–source UF_4. This blended salt gave high metal yields. Mixtures of 20% HF and 80% H_2O were vaporized, the HF was adsorbed on NaF, and anhydrous HF was desorbed from the $NaHF_2$. A rapid method for the x-ray spectrometric determination of 0.1 to 2% thorium in uranium concentrates was adopted. Cerium in ura-

nium products may be determined by the same spectrographic procedures used for the other rare earths. A greater than 95% recovery of platinum was obtained from a Pt–U–graphite residue. (auth)

23570 (NYO-2580) APPLICATIONS OF ULTRASONIC ENERGY. TASK 1: ULTRASONIC CHEMICAL PROCESSING. TASK 2: ULTRASONIC METAL AND CERAMIC POWDER PROCESSING. TASK 3: ULTRASONIC INSTRUMENTATION. Progress Report No. 24, October 1, 1960 to November 31, 1960. (Aeroprojects, Inc., West Chester, Penna.). Dec. 1960. Contract AT(30-1)-1836. 28p.

Ultrasonic pyrometallurgical dissolution of uranium metal by molten zinc resulted in increased rate and complete solution of uranium in contrast to only 14% without ultrasonic activation. An alumina mixture containing 12.6% moisture was extrudable with ultrasonic die activation. This is a substantial reduction of moisture content over the driest material previously extruded, at comparable pressures and rates, without ultrasonics. Magnesium oxide formulations with various moisture contents were extruded, and ultrasonic activation produced the expected increase in rate, decrease in pressure, and improved surface finish. Ultrasonic vibratory filling of thin-walled tubes with ceramic-grade UO_2, low-fired thoria, and arc-fused optimum-sized UO_2 resulted in compact densities comparable to those obtained by 55-ton compression methods. It was demonstrated that by the acoustic-impedance-ratio technique it is possible to detect changes in aqueous slurry concentration and to discriminate between 3-μ and nominal 40-μ particles. Studies are in process to improve sensitivity and discrimination so the concept can be applied to gaseous suspensoids. The determination of the incidence of boiling in pressurized water by cavitation threshold variation appears possible. Adequate sensitivity should be obtainable with minor changes in existing systems. (auth)

23571 (NYO-2581) APPLICATIONS OF ULTRASONIC ENERGY TO PYROMETALLURGICAL AND PYROCHEMICAL PROCESSING OF NUCLEAR MATERIALS. C. Dana McKinney, William B. Tarpley, and Robert S. Winchester (Aeroprojects, Inc., West Chester, Penna.). Apr. 1961. Contract AT(30-1)-1836. 42p.

The feasibility of nuclear fuel reprocessing applications of ultrasonic energy was studied. Ultrasonic treatment apparatus was designed and constructed. Ultrasonic activation of molten metal systems was found to reduce from days or weeks to 2 to 4 hr the time required to dissolve uranium and uranium/fissium in molten cadmium or zinc. Quantitative ultrasonic reduction of uranium oxide (U_3O_8) in the molten magnesium, cadmium, or zinc systems required less than 8 hr of treatment time; nonultrasonic, mechanically stirred controls yielded only 9 to 11% recoveries under the same conditions. Ultrasonic mixing accelerated three to four fold the rate of extraction of copper from mercury by dilute nitric acid, a system designed to simulate the relative behavior of uranium and magnesium at 900°C. Oxide fuel pin casings which prevent the coalescence of molten uranium were shattered and dispersed by an ultrasonic probe at 1200°C at treatment times of only 2 min. Ultrasonic activation of a molten salt system (lithium and sodium fluorides) was demonstrated. Application of these interphase accelerations to larger scale and continuous processing was briefly described. (auth)

23572 (TID-13223) RADIOCHEMICAL SEPARATION OF CADMIUM BY AMALGAM EXCHANGE. J. R. DeVoe, H. W. Nass, and W. W. Meinke (Michigan. Univ., Ann Arbor). [1961]. Contract [AT(11-1)-70]. 16p.

The radiochemical separation of cadmium by an amalgam exchange technique was critically evaluated. In the procedure, the cadmium amalgam exchange step is followed by a back extraction with thallous ion to selectively remove the cadmium from contaminants in the mercury. Cadmium yields of 80% were obtained with less than 0.1% contamination of most typical elements. Indium, thallium, and selenium contaminate the separation to a greater extent. The procedure can be carried out in 8 minutes with no special equipment. Mineral acids below 1 M do not affect the exchange but oxidizing agents such as U^{6+} and Ce^{4+} must be given special attention. (auth)

23573 (TID-13224) RADIOCHEMICAL SEPARATION OF INDIUM BY AMALGAM EXCHANGE. R. R. Ruch, J. R. DeVoe, and W. W. Meinke (Michigan. Univ., Ann Arbor). [1961]. Contract AT(11-1)-70. 16p.

The radiochemical separation of indium by an amalgam exchange technique was critically evaluated for the aqueous hydrogen bromide system. The efficiency and contamination of the separation were studied using tracers of 19 different representative elements. Yields of contaminating elements are reduced in most cases to less than 0.1% while indium yields are usually above 95%. The procedure requires no special equipment and takes about 11 minutes over-all. A number of factors affecting the separation were studied and optimized. (auth)

23574 (CEA-tr-X-358) SEPARATION DU RUTHENIUM PAR LA RESINE ECHANGEUSE CATIONIQUE. (Separation of Ruthenium with Cation Exchange Resins). K. Hayashi, S. Gamame, and Ya. Uzumasa. Translated into French from Bunseki Kagaku, 8: 821-2(1959). 14p.

The order of magnitude of the effect of the medium acidity on the separation of Ru^{3+} and Ru^{4+} on cation exchange resins was investigated experimentally. Ru^{106} was used as tracer. The variation of the separation yield was determined as a function of the normality of the solution. The results show that ion exchange on cation resins can be used to separate more than 99% of the Ru from other cations. (J.S.R.)

23575 (DEG-Inf-Ser-315) EXTRACTION OF PLUTONIUM BY MEANS OF TRIBUTYL PHOSPHATE. PART 2. EFFECTS OF TEMPERATURE ON PARTITION OF Pu(IV). E. I. Moiseenko and A. M. Rozen. Translated by M. McCarthy for U.K.A.E.A., Development and Engineering Group from Radiokhimiya, No. 3, 274-80(1960). 8p.

A study was made of the distribution of Pu^{4+} for various temperatures in extraction by 20% TBP in hydrogenates kerosene in relation to the equilibrium content of uranyl nitrate and nitric acid in the aqueous phase. The distribution coefficients pf Pu^{4+} at 0.1 to 10.0M acidity and 0.021 to 1.26M uranyl nitrate concentration at 20, 30, 50, and 70°C show that with acidities up to 5M the coefficient decreases with temperature in the absence of uranyl nitrate, while at higher acidities it increases. The first effect is explained by a decrease in the distribution constant with temperature and the second by an increase of the activity coefficients. An approximate assessment was made of the thermodynamic distribution constants of Pu^{4+}, the activity coefficients in the aqueous phase, and the heat of extraction. (P.C.H.)

23576 STUDY ON INDUSTRIAL ION EXCHANGE SEPARATION OF RARE EARTH ELEMENTS BY EDTA COPPER METHOD. I. RECOVERY OF EDTA AND COPPER. K. Nishigori, T. Ishiyama, and T. Kuroda. Denki Shikensho Ihō, 25: 205-9(Mar. 1961). (In Japanese)

23577 STUDY OF INDUSTRIAL ION EXCHANGE SEPARATION OF RARE EARTH ELEMENTS BY EDTA COPPER METHOD. II. ION EXCHANGE SEPARATION USING A

SMALL COLUMN. K. Nishigori, T. Ishiyama, and T. Kuroda. Denki Shikensho Ihô, 25: 210-15(1961). (In Japanese)

23578 STUDIES ON COUNTERCURRENT EXTRACTION OF RADIONUCLIDES. I. COUNTERCURRENT SEPARATION OF FISSION PRODUCTS IN THE SYSTEM TRI-N-BUTYL PHOSPHATE-HYDROCHLORIC ACID. Tomitaro Ishimori (Japan Atomic Energy Research Inst., Tokyo). and Hassan M. Sammour. J. At. Energy Soc. Japan, 3: 344-52(May 1961). (In English)

Applications of discontinuous countercurrent solvent extraction techniques in problems of radiochemical separations are studied. Individual distributions of simple constituents of fission products, as well as countercurrent separation of these elements from 100 to 200 day old fission product mixtures, are tried in a 100% TBP–HCl system. The best conditions for mutal separation of zirconium from niobium, as well as separation of these two elements from ruthenium and the other fission products, are investigated. (auth)

23579 A SUGGESTED METHOD FOR THE CHEMICAL REPROCESSING AND PURIFICATION OF Th–U–O SLURRY-TYPE REACTOR FUELS. Donald G. Gardner (Westinghouse Electric Corp., East Pittsburgh). Nuclear Sci. and Eng., 10: 228-34(July 1961).

A new approach to the chemical reprocessing of contaminated Th–U–O slurry-type reactor fuels is suggested which avoids the complete dissolution of the slurry particles. The method is based on the elution of adsorbed contaminants from specially treated surface of the slurry particles using hot dilute nitric acid. In particular, the adsorption and elution properties of this type of slurry with respect to 0.004 M cerium were determined. (auth)

23580 INVESTIGATIONS WITH IRIDIUM-192 OF SEPARATIONS OF PLATINUM AND RHODIUM FROM IRIDIUM. [PART] I. K. W. Lloyd and D. F. C. Morris (Brunel Coll. of Tech., London). Talanta, 7: 117-20 (Nov.-Dec., 1960). (In English)

Ir^{192} was used as a tracer to study the interference of iridium in the quantitative analysis of platinum and rhodium by the classical method of Gilchrist and Wichers and by the new method of Payne. (auth)

23581 PHYSICAL-CHEMICAL PROPERTIES OF PLUTONIUM CUPFERRON. I. V. Moiseev, N. N. Borodina, and V. T. Tsvetkova. Zhur. Neorg. Khim., 6: 543-8(Mar. 1961). (In Russian)

The composition, dissolution, and extraction of products of tri-, tetra-, and hexavalent plutonium with cupferron in acid solutions were investigated. It was found that regardless of the plutonium valence state the composition of the resulting product is $Pu(C_6H_5N_2O_2)_4$. The dependence of plutonium(IV) cupferron dissolution on sulfuric acid concentration and cupferron saturation was analyzed and approximate values are given: $K_s = (H^+)^4/[P(IV)][HR]^4 = 6.6 \times 10^{13}$ and $L_s = [Pu(IV)][R^-]^4 = 1.2 \times 10^{-31}$. Extraction of Pu(IV) with cupferron from sulfuric acid solutions was studied. The constant describing the $PuR_4–HR–H_2O–CHCl_3$ system at 20 ± 1°C was: $K_e = [PuR_4]CHCl_3/[Pu(IV)]H_2O \cdot (H^+)^4/[HR]^4CHCl^3 = 1.1 \times 10^7$. (R.V.J.)

23582 IMPROVEMENTS IN OR RELATING TO ELECTROLYTIC TRANSPORT OF METALS. John Michael Cox, David Anthony Everest, and Ronald Alfred Wells (to United Kingdom Atomic Energy Authority). British Patent 870,065. June 14, 1961.

A process for separating metal present as an anionic complex in a solution which is passed through an electrolytic cell is described. The anode compartment contains sodium sulfate. The compartment is separated from the solution by an anion-exchange membrane derived from an organic polymer containing co-valently bound chlorine by replacing the chlorine with basic nitrogen-containing groups. The organic polymer is polyvinyl. Hexamethylene diamine is used to replace the chlorine in the polymer. The cathode compartment is separated from the solution by the anion-exchange membrane and contains either sodium sulfate or magnesium sulfate. This method may be applied to either thorium or uranium by introducing the metal in the form of a pulp with a solids content of at least 50% by weight and with a pH between 1.5 and 2.0. The solution may be that from a sulfuric acid leach process. (N.W.R.)

23583 SEPARATION OF LANTHANONS FROM THORIUM. Leonard George Sherrington (to Thorium, Ltd.). British Patent 870,950. June 21, 1961.

A process for separating rare earth ions from thorium ions is described. An aqueous feed solution containing the rare earth, thorium, and phosphate ions is contacted with a strongly acidic cation-exchange resin to remove the rare earth ions from the feed solution. The resin is then separated from the feed solution. The resin is a polymer or copolymer of styrene and contains a sulfonic acid grouping. The rare earths absorbed on the resin are removed by treating the resin with hydrochloric acid which elutes the rare earths in the form of chlorides. Before treating with hydrochloric acid the resin is washed with dilute hydrochloric acid. (N.W.R.)

23584 EXTRACTION OF THORIUM AND LANTHANONS FROM MONAZITE. William Palmer Kemp and James Johnson (to Thorium, Ltd.). British Patent 871,107. June 21, 1961.

A process for separating thorium and the rare earths from a filtered acidic extract of monazite is described. The process consists of adding sodium chloride or potassium chloride and hydrochloric acid to the filtered acidic extract to precipitate the thorium and rare earths in the form of sulfate, and removing the resulting precipitate containing thorium and rare earths. The sulfuric acid concentration in the filtrate should be from 4.5 to 5.5 N. The alkali metal chloride should be added in an amount such that the filtrate contains from 200 to 400 g/l of chloride. (N.W.R.)

23585 PURIFICATION OF NUCLEAR REACTOR FUELS. (to U. S. Atomic Energy Commission). British Patent 871,314. June 28, 1961.

A method for removing fission products from liquid metal reactor fuels in which the fissionable material consists predominantly of plutonium is described. The process consists of placing at least one immiscible liquid metal in contact with the liquid fuel and allowing the immiscible liquid metal to remain in contact with the fuel until at least part of the fission products have transferred to the immiscible liquid metal. The immiscible liquid metal is characterized by its affinity for fission products. The liquid metal is silver, lanthanum, alkaline earth metal, or alkali metal. (N.W.R.)

23586 IMPROVEMENTS IN LIQUID-LIQUID EXTRACTION APPARATUS. (to Allmanna Svenska Elektriska, A. G.). British Patent 871,539. June 28, 1961.

A description is given of a liquid-liquid extraction apparatus and of the method of effecting a net transportation in opposed directions of a heavy liquid and a light liquid. The apparatus consists of a plurality of series-connected ves-

sels, inlet and outlet means for the phases at the ends, and a pulsing means. The upper part of one vessel is joined to the lower part of the next vessel by one connection line or a plurality of parallel-connected lines. The lower part of the second vessel is below the upper part of the first vessel. The volume of each connection line is less than or the same as the volume displaced by one stroke of the pulsing means. The method is characterized in that a mixture of both liquids is caused to flow to and fro between adjacent vessels through the connection lines which joins the vessels. (N.W.R.)

23587 PROCESS FOR RECOVERY OF NUCLEAR FUEL FROM USED FUEL ELEMENTS. (to Carborundum Co.). British Patent 871,692. June 28, 1961.

A process for the recovery of fissionable or fertile constituents from used or spent nuclear fuel elements of the solid type is described. The fuel elements consist of uranium, plutonium, thorium or mixtures thereof, and metallic material of zirconium, hafnium, titanium, or their alloys. The process consists of immersing the fuel element in a solution of ammonium fluoride, and dissolving at least a part of the fuel element therein. The concentration of the ammonium fluoride is from 10 to 50% and is maintained between 25°C and the boiling point of the solution. Ammonium bifluoride may be used for the process. A diagram of the process is given. (N.W.R.)

23588 IMPROVEMENTS IN OR RELATING TO THE RECOVERY OF URANIUM. David Watson Clelland and Edward John Cullen (to United Kingdom Atomic Energy Authority). British Patent 872,324. July 5, 1961.

A method of recovering uranium from magnesium fluoride or calcium fluoride slags is described. These slags arise in the production of uranium from uranium tetrafluoride. The method consists of grinding the slag dry and then slurrying with nitric acid. The resultant slurry is fed to a packed, pulsed counter-current extraction column having an unpacked disengagement section at its base. An organic solvent for uranium flows upward and the slurry flows downward in the column. The interface between the two phases is within the disengagement section, and the packing and pulsing is arranged so that the discontinuous phase flows over the packing and through the continuous phase as a film. The packing consists of glass spheres supported in the column on a conical sieve plate. A diagram is given of the process and the equipment used. (N.W.R.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

23589 (AERE-R-3661) THE DISTRIBUTION OF RADIOACTIVE MATERIALS IN A CIRCUIT. J. Pattison and G. N. Walton (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment; Harwell, Berks; England). Apr. 1961. 23p.

Equations are developed for the distribution in a circuit of material which is rapidly deposited on the walls of the system, and slowly removed from the walls by the circulating fluid. Solutions of the equations are compared with the results obtained for the transport of activated corrosion products in a high temperature pressurized water loop. The results show that deposition and emission for uncorroded surfaces are faster than those for corroded surfaces. Estimates are made of the effective corrosion rate, and of the "residence time," of material deposited on surfaces. (auth)

23590 (DMIC-Memo-116) GENERAL RECOMMENDATIONS OF DESIGN FEATURES FOR TITANIUM AND ZIRCONIUM PRODUCTION-MELTING FURNACES. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). July 19, 1961. 10p.

An outline of recommendations on the design features for titanium and zirconium melting furnace is presented. Over-all construction crucibles or molds, interlocks to prevent or stop power to the arc, warning devices, visual observation, and recording instruments are discussed. (M.C.G.)

23591 (JINR-P-396) MISHEN DLYA ZHIDKOGO VODORODA I DEITERIYA. (The Target for Liquid Hydrogen and Deuterium). A. V. Bogomolov, V. G. Vovchenko, V. V. Svyatkovskii, L. M. Soroko, and I. A. Shtyrii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1959. 37p.

The construction of liquid hydrogen and deuterium targets that may be stored for 40 to 50 hours is described. The targets may be used in investigations of fast charged particle interactions under conditions of well-described geometry. Data are presented on the performance of the target during an investigation of $p + p \rightarrow d + \pi^+$ reactions using polarized proton beams at 538, 616, and 654 Mev. Another target was used for investigating π meson production in p-d interactions at 660 Mev. (R.V.J.)

23592 (NDA-Memo-2145-3) PHILOSOPHY OF DESIGN FOR THE NDA PLUTONIUM FACILITY. E. D. Oppenheimer and S. Lazarus (Nuclear Development Corp. of America, White Plains, N. Y.). Apr. 15, 1960. 28p.

A statement is presented of the basic points of design philosophy which will be used as a guide in the design of a facility for handling, analyzing, cladding and performing other operations on plutonium carbide. Types of hazards associated with plutonium include toxicity, pyrophoricity, and nuclear reactivity. (J.R.D.)

23593 (NP-10394) ON THE TRANSLATORY WHIRL MOTION OF A VERTICAL ROTOR IN PLAIN CYLINDRICAL GAS-DYNAMIC JOURNAL BEARINGS. C. H. T. Pan and B. Sternlicht (General Electric Co. General Engineering Lab., Schenectady, N. Y.). May 8, 1961. Contract NONR 2844(00). 33p.

Various dynamical aspects of plain cylindrical journal bearings are considered. The discussion is devoted to an understanding of the dynamical characteristics of a rotor system for which it is necessary to have accurate knowledge of the bearing fluid film forces under such conditions. (J.R.D.)

23594 (SCNC-292(Del.)) DESIGN, CONSTRUCTION AND OPERATION OF A HOT AIR BURNER RIG TEST FACILITY. S. Priceman, L. Sama, and H. P. Kling (Sylvania-Corning Nuclear Corp., Bayside, N. Y.). Jan. 1960. Decl. with deletions June 14, 1960. Contract AT-30-1-GEN-366. 27p.

A program for the development of oxidation-resistant materials for high temperature applications required means for adequately evaluating the results of this work. A propane fired hot air burner test facility was designed and constructed for this purpose. The design required temperatures in excess of 2000°F and dynamic heads greater than 6 psi. Operation of the equipment at these performance levels was accomplished. A number of test samples fabricated of materials developed in this laboratory were tested in this rig at levels up to the maximum design conditions for extended time periods. (auth)

23595 (TID-5402(Del.)) PERFORMANCE OF O-RINGS IN THE NYX REACTOR. E. C. Bertsche (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). Mar. 1953. Declassified with deletions May 4, 1960. Contract AT(07-2)-1. 86p.

Tests are reported which show that O-rings will perform satisfactorily in the SRP reactors. Experiments with the NYX prototype led to O-ring design modifications in areas concerned with cross sectional diameter, composition, lubrication, and minimum squeeze limits. (J.R.D.)

23596 (TID-12825) GAS FILTERS. SPECIFICATION FOR EXPERIMENTAL GAS COOLED REACTOR—Specification No. PK-12. Louis Vigil and Frank Caplan (Kaiser Engineers. Div. of Henry J. Kaiser Co., Oakland, Calif.). Apr. 26, 1960. 15p.

There may be further revisions and addenda issued to this specification.

Specifications are included for the procurement of high-efficiency and porous-metal gas filters, and an iodine remover for use in the EGCR. Cleanliness requirements and pressurized shipping instructions are included. (B.O.G.)

23597 (TID-13227) APPARATUS FOR CLEAVING METAL CRYSTALS IN VACUUM. James B. Drew (Franklin Inst. Labs. for Research and Development, Philadelphia). 1960. 6p.

An apparatus is described for cleaving metal crystals at low temperatures in vacuum down to 10^{-6} mm Hg. The apparatus is a cell containing an internal Dewar vessel filled with liquid N_2 and attached at its bottom to a flat hollow cooling pedestal which holds the crystal. Cleaving is accomplished by a steel needle or knife edge positioned above the crystal. Means are arranged for heating the crystal after cleaving. A Zn crystallite grown on a cleaved Zn surface is described. (D.L.C.)

23598 (WAL-TR-893.3/3(Rev. Ed.)) ON THE BASIC THEORY OF THIN CYLINDRICAL SHELLS. Oscar L. Bowie (Watertown Arsenal Labs., Mass.). June 1961. 32p.

A three-dimensional solution for cylindrical shells is considered and sets of solutions satisfying the exact equilib-

rium equations are generated. A revision of the procedure for approximating the boundary conditions is presented. This procedure is based on an order of magnitude estimate of the generating displacement coefficients of the solution and leads to an effective scheme for determining the form of solution. Using this approach, the range of applicability of conventional thin shell theory can be extended to moderately thick cylinders. The solution is carried out numerically for the case of bending moments acting on the ends of the cylinder. (auth)

23599 (WT-1474) TEST OF BURIED STRUCTURAL-PLATE PIPES SUBJECTED TO BLAST LOADING. R. A. Williamson and P. H. Huff (Holmes and Narver, Inc., Los Angeles). Aug. 1960. Project 34.3 [of] Operation PLUMBBOB. 48p.

Two 20-ft-long, 7-ft-diameter, 10-gage structural plate pipes, having longitudinal joints with eight bolts per foot, were buried 10 ft over the crown of the pipe and tested at predicted pressure levels of 190 and 245 psi. Data showed that the pipe could be used as a partial substitute for heavy concrete tunnel sections in the construction of scientific stations at ranges close to nuclear detonations. However, in view of the nontypical soil conditions that exist at the Nevada Test Site, the results may not be applicable to other locations. Maximum transient changes in vertical and horizontal diameters, measured by self-recording gages, were about $\frac{7}{8}$ and $\frac{3}{8}$ in., respectively. Maximum residual changes in the same diameters were about $\frac{3}{4}$ and $\frac{1}{4}$ in., respectively. Discrepancies were found between measurements of the residual changes recorded by the gages and measurements obtained visually before and after the event. Slip in the bolted joints was negligible. (N.W.R.)

23600 (ZR-1001-4) DEVELOPMENT OF A HIGH-TEMPERATURE NUCLEAR-RADIATION-RESISTANT PNEUMATIC POWER SYSTEM FOR FLIGHT VEHICLES. Fourth Monthly Progress Report, Phase I Reporting Period December 21, 1960 to January 20, 1961. (Convair, San Diego, Calif.). Contract AF 33(616)-7582. 98p.

Activities in a program to develop high-temperature nuclear-radiation-resistant power systems for operational support of flight vehicles are described. Progress in the areas of dynamic system studies, material studies, and power systems is described. (J.R.D.)

23601 (AEC-tr-4647) DETERMINATION OF THERMAL CONDUCTIVITY WITH THE POENSGEN APPARATUS. Max Willy Klempin. Translated from Tonind. Ztg. u. Keram. Rundschau, 78: 9-11(1954). 5p.

A discussion is given of the design characteristics of an apparatus for the determination of the thermal conductivity of a material. A schematic of the Poensgen design is included. Formulas used in conjunction with the apparatus for making the calculations are given. (B.O.G.)

23602 OPTIMALIZATION OF MULTI-DIMENSIONAL CONTROL SYSTEMS BY MONTE CARLO METHODS. R. Kulikowski (Inst. of Fundamental Technical Problems, Polish Academy of Sciences). Bull. acad. polon. sci., Sér. sci., tech., 9: No. 2, 113-21(1961). (In English)

A method is described whereby a slowly varying, multidimensional, nonlinear system may be controlled by a random search technique. The Monte Carlo method is used, along with an important sampling process that reduces statistical variances. The technique is effective at high noise levels. (T.F.H.)

23603 THE YIELDED COMPOUND CYLINDER IN GENERALIZED PLANE STRAIN. S. J. Becker (Westinghouse Electric Corp., Bettis Atomic Power Lab., Pittsburgh). J. Eng. Ind., 8p. (1960). (WAPD-T-1138)

The theory of a previous paper on plane strain in a compound cylinder is extended to generalized plane strain, where the axial strain is a constant nonzero value for every radius and depends only on the external and internal pressures and any extraneous axial load. The method is limited to incompressible elastic material and is found to be completely solvable only if an elastic zone exists in each component. The assumed Tresca yield condition is verified in the process of obtaining the complete solution. (auth)

23604 AN ANALYSIS OF THE YIELDED COMPOUND CYLINDER. S. J. Becker (Westinghouse Electric Corp., Bettis Atomic Power Lab., Pittsburgh). J. Eng. Ind., 43-7 (Feb. 1961). (WAPD-T-1003)

An analysis is made of the partially plastic range, restricted to plane strain, of the compound cylinder, made by shrinking together many concentric cylinders. An example is given using a cylinder designed to yield simultaneously in all its components. A comparison is made between a structure with a compressible elastic material and one with an incompressible elastic material. Finally, an important auto-frettage formula is developed. (auth)

23605 MEASUREMENT OF THE MOISTURE CONTENT IN GROUND AND BUILDING MATERIALS. Z. Milavc (Nuklearni Inštitut "J. Stefan," Ljubljana, Yugoslavia). Nova Proizvodnja, 11: 263-7(1960). (In Yugoslavian)

A non-destructive method for measuring the moisture content in ground and building materials is described. The method is based on the slowing down of fast neutrons. Results are given for the water-permeability of a concrete tunnel wall of a hydroelectric power plant. Data are also presented on the calibration of an instrument with 2π geometry. The moisture is compared with a paraffin standard. (N.W.R.)

23606 IRRADIATION TECHNIQUES FOR FISSILE MATERIALS-5. O. S. Plail (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Power, 6: No. 61, 82-6(May 1961).

The development and construction of hot cells for handling irradiated fissile materials is presented. Designs are presented for old and new cells along with the materials and techniques used in making these cells. Cells for use as metallographic facilities are also discussed. (N.W.R.)

23607 MULTIPLE CATHODE SPUTTERING SYSTEM. John G. Simmons and Leon I. Maissel (Philco Corp., Blue Bell, Penna.). Rev. Sci. Instr., 32: 642-5(June 1961).

The development of a multiple cathode sputtering system is described. The major advantage of a sputtering system is that highly refractory materials can be sputtered quite readily, whereas they cannot be evaporated without elaborate equipment. Thus, a sputtering system permits studies of thin metal films from those with low melting points to those with high melting points. A sputtering system is described that uses several cathodes and a rotating anode. This system makes possible sputtering of one metal after another without breaking the vacuum, and deposition of films of various thicknesses under identical conditions. (auth)

23608 MAGNETICALLY SUSPENDED EQUILIBRIUM ULTRACENTRIFUGE. J. W. Beams, R. D. Boyle, and P. E. Hexter (Univ. of Virginia, Charlottesville). Rev. Sci. Instr., 32: 645-50(June 1961).

A magnetically supported equilibrium ultracentrifuge is described for the determination of molecular weights and molecular weight averages. The rotor is magnetically suspended in a vacuum, and is driven to operating speed by an electric motor or by an air turbine. The rotor is allowed to "coast" freely during the course of the sedi-

mentation and loses about 1 rps per day. A Jamin interferometer is used to measure the concentration in the ultracentrifuge cell both before and after equilibrium has been established. A precision of the order of 0.1% is obtained for monodisperse substances over a very wide molecular weight range. (auth)

23609 NEUTRON SPECTROMETER FOR PRODUCING PURE MONOCHROMATIC BEAMS IN THE THERMAL REGION. H. Bjerrum Møller, F. J. Shore, and V. I. Sailor (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instr., 32: 654-8(June 1961). (BNL-5153)

The combination of a Si (111) monochromator and a quartz "single-crystal" filter proves effective for the elimination of higher-order contamination from the monochromatic beam of a neutron crystal spectrometer in the energy range from ~0.02 to 0.10 ev. This system greatly enhances the usefulness of crystal spectrometers for obtaining cross section data in the thermal range. The properties of the quartz filter are studied at room temperature and 77°K, and it is shown that the filter is more efficient at room temperature. The higher-order contaminations from Si (111) and NaCl (200) reflections are compared, and it is clearly demonstrated that Si (111) is a superior monochromator in the thermal region. (auth)

23610 ION-FOCUSING PROPERTIES OF A THREE-ELEMENT QUADRUPOLE LENS SYSTEM. Harald A. Enge (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instr., 32: 662-5(June 1961).

The focusing properties of a three-element quadrupole lens system are studied. The results of thick-lens calculations are presented, showing the field-strength parameters and magnifications as functions of object and image distances. (auth)

23611 DESIGN AND CONSTRUCTION OF A SYSTEM OF PULSED MAGNETS. R. L. Kuskowski, T. B. Novey, and S. D. Warshaw (Argonne National Lab., Ill.). Rev. Sci. Instr., 32: 674-82(June 1961).

A system of two pulsed iron-free magnets, designed for an experiment in high energy physics, is described. One of these is a small solenoid, with a working volume of about 35 cm^3, pulsed at 200 kgauss; the other is a large magnet with a volume of about 6 liters, pulsed at a nominal 15 kgauss. Construction details, working lifetimes, and details of switch gear are discussed. (auth)

23612 CONTINUOUSLY OPERATING He^3 REFRIGERATOR FOR PRODUCING TEMPERATURES DOWN TO $\frac{1}{4}$°K. E. Ambler and R. B. Dove (National Bureau of Standards, Washington, D. C.). Rev. Sci. Instr., 32: 737-9(June 1961).

A continuously operating portable He^3 refrigerator is described. The He^3 is recirculated in a system that operates without mechanical pumps. The throttling of the returning liquid is accomplished by means of a porous plug. Regulation is obtained by using a system that allows the pressure across the porous plug to vary with the circulation rate. The lowest temperature reached while circulating is 0.26°K at zero "external" heat input, and 0.40°K at 2 mw. (auth)

23613 A HYDROGEN CONDENSATION PUMP. B. G. Lazaryev, E. S. Borovik, M. F. Fedorova, and N. M. Tsin (Inst. of Physics and Tech., Academy of Sciences, USSR). Ukrain. Fiz. Zhur., 2: 176-82(Apr.-June 1957). (In Ukrainian)

An application is made of the fact that the vapor pressure of most gases pumped out with a high vacuum pump is very low (for example, for nitrogen $p \approx 10^{-10}$ mm Hg). On this basis a method for obtaining high vacuum (10^{-8} to 10^{-10} mm Hg) is developed, by obtaining a high condensation rate of pumped gases on a surface cooled by liquid hydrogen. Two types of such pumps are investigated. One has a pumping rate of 13,000 l/sec with the pumping element inserted into the evacuated space, and the other has a pumping rate of about 4000 l/sec in the form of a flanged unit inserted into the vacuum line gap between the evacuated object and the ordinary diffusion pump. The designs described can be employed with the usual vacuum technique (steel vacuum lines and recipients, rubber gasketed flanges, metal vacuum valves). (auth)

23614 SPRAY LITERATURE ABSTRACTS. Kalman J. DeJuhasz, comp. and ed. New York, The American Society of Mechanical Engineers, 1959. 387p.

Over 1300 abstracts dealing with the scientific, technical, and industrial aspects of sprays are included. The information collected from the literature of 23 countries, covers the period from about 1880 to 1958. Special attention is paid to giving detailed information on the topic and scope of each entry, and also on the affiliation of each author wherever available, in an endeavor to aid the reader in his search, help avoid duplication of effort, and possibly promote a cross-fertilization of ideas by calling attention to related work described in obscure and remote sources. Information having a bearing on the theoretical and experimental study of sprays is also contained. (N.W.R.)

23615 IMPROVEMENTS IN OR RELATING TO SEALING DEVICES. Alan Joseph Gaunt and Ronald Albert Redford (to United Kingdom Atomic Energy Authority). British Patent 870,351. June 14, 1961.

A sealing device, which is simple in design, reliable in operation, and easily manipulated by remote handling equipment, is described for a vacuum apparatus. The device consists of an open receptacle perforated by an open-ended stand pipe adapted to communicate with the apparatus. The receptacle is provided with an internal seating, a sealing cap insertable into the receptacle so as to surround the open-ended portion of the stand pipe, and a resilient seal between the cap and the receptacle seating. When the stand pipe is placed in communication with vacuum and with high density liquid in the receptacle, the sealing cap is urged by ambient pressure on to the seal and together with the high density liquid seals off the stand pipe end. The resilient seal is attached to the sealing cap. The upper end of the sealing cap is transparent. (N.W.R.)

23616 IMPROVEMENTS IN OR RELATING TO FLUID-TIGHT SAFETY VALVES. (to Commissariat a l'Energie Atomique). British Patent 870,602. June 14, 1961.

A safety valve design is presented. The safety valve consists of a valve seat and a valve member biased thereagainst, a diaphragm forming a seal downstream of that provided by the valve member and the valve seat, and a seal rupturing member normally downstream of and biased toward the diaphragm. Means are provided for locking the seal rupturing member in the inoperative position. The locking means is releasable by lock release means responsive to fluid pressure in the vessel. The lock means consists of a detent held in the locking position by a level operable to release the detent by an expandable chamber in communication with fluid in the vessel. (N.W.R.)

23617 IMPROVEMENTS IN OR RELATING TO CENTRIFUGAL PUMPS AND APPARATUS FOR SAMPLING RADIO-ACTIVE LIQUIDS. Edward Duncombe and Harold Pugh (to United Kingdom Atomic Energy Authority). British Patent 870,829. June 21, 1961.

The design of a centrifugal pump and supporting apparatus for sampling radioactive liquids is described. The pump consists of a shaft carrying an impeller and arranged so that the shaft can be supported on an air lubricated

thrust bearing, centralized by spaced air lubricated journal bearings, and rotated by the rotor of an air-powered turbine. The apparatus consists of a biological shielding containing a pipe for radioactive liquors and a pipe outside the shielding for radioactive liquors drawn off from the pipe inside the shielding. The centrifugal pump has its inlet communicating with the pipe inside the shielding and its outlet connected with an outlet pipe coupled to the pipe outside the shielding. Features of the apparatus include the fact that the pump is located within a casing extending from outside the shielding to be integral with the pipe inside the shielding, and the pump is removable from the casing through an aperture accessible from outside the shielding. (N.W.R.)

23618 IMPROVEMENTS IN VALVES FOR CONTROLLING GAS STREAMS FLOWING AT VERY LOW FLOW RATES. Pierre Maurice Roubean, Jean-Marie Garin, and Pierre Prugne (to Commissariat a l'Energie Atomique). British Patent 872,741. July 12, 1961.

Valves which may be used for supplying ion sources with the desired amount of gas or for measuring the pumping rates of a molecular vacuum pump are described. The valve consists of a cylindrical metallic body which is perforated at one axial end with an opening providing a valve seat. There is a needle-forming element which is disposed axially in the interior of the body and is made of a metal or alloy having the same thermal expansion coefficient as the body. The free end of the element is capable of fitting into the valve seat and the other end is rigid with the body. There are means to admit the gas to be controlled to the interior and means for regulating the longitudinal position of the free end relatively to the seat by modifying the degree of compression of the cylindrical body in the axial direction. The regulating means consists of a first means allowing for the initial regulation and a second means separate from the first means enabling the position, thus adjusted, to be modified with precision. Curves illustrating the results obtained with the valve are presented. (N.W.R.)

Heat Transfer and Fluid Flow

23619 (AFOSR-627) A MONTE CARLO SOLUTION FOR HEAT TRANSFER IN RAREFIED GASES. Laboratory Report No. 61-3. Milton L. Lavin (Massachusetts Inst. of Tech., Cambridge. Fluid Dynamics Research Lab.). May 1961. Contracts AF 49(638)-207 and AF 1919(604)-5698. 165p.

The nonlinear heat transfer problem in the transition regime between free molecule and continuum flow is solved by an iterative Monte Carlo method, and the results are compared with both linear and nonlinear analytical solutions. One of the nonlinear solutions obtained by Lees' full-range moment method has not been presented before. The statistical procedure consists of constructing an improved distribution function by recording the history of a single test molecule which wanders through a phase space populated by molecules of the previous iterate. Molecular wanderings are determined by selecting events at random from the probability distributions that govern the interaction process. For a nominal Knudsen number of 2.0 and a temperature ratio of 4:1, the Monte Carlo results differ from both the linear and nonlinear analytical solutions by no more than 10 to 15%. Moreover, these statistical results seem to substantiate Mott-Smith's prediction of a Knudsen layer adjacent to the boundary. (auth)

23620 (CEA-1853) ETUDE EXPERIMENTALE DES COEFFICIENTS D'ECHANGES THERMIQUES, DES FLUX DE CHALEUR CRITIQUES ET DES PERTES DE CHARGE AVEC DES MELANGES DAU-VAPEUR EN ECOULEMENT TURBULENT DANS UN TUBE VERTICAL. (Experimental Study of Heat Exchange Coefficients, Critical Heat Fluxes and Charge Losses, Using Water-Steam Mixtures in Turbulent Flow in a Vertical Tube). P. Perroud, A. de La Harpe, and J. Rebiere (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Grenoble). 1960. 76p.

Two stainless steel tubes were used (ϕ 5 and 10 mm, lengths 400 and 800 mm respectively), heated electrically (50 Hz). The mixture flows from top to bottom. The work was carried out mainly on mixtures of high concentration ($x > 0.1$), at pressures between 50 and 60 kg/cm^2, flowing as a liquid film on the walls of the tube with droplets suspended in the central current of steam. By analysis of the heat transfer laws the exchange mechanisms were established, and the conditions under which the critical heat flux may be exceeded without danger of actual burnout were determined. High output concentrations ($x_s > 0.9$) may be obtained. An attempt was made to find to what extent existing correlation formulas can be used to account for the phenomena observed. It is shown that those dealing with exchange coefficients can only be applied in a first approximation in cases where exchange by convection is preponderant, and only below the critical flux. The formulas proposed by WAPD and CISE do not give a satisfactory estimation of the critical heat fluxes, and the essential reasons for this inadequacy are explained. Lastly, the Martinelli and Nelson method may be used to an approximation of 30% for the calculation of charge losses. (auth)

23621 (IDO-16644) A TWO-DIMENSIONAL STEADY STATE TEMPERATURE PROGRAM FOR THE IBM-650 (TDTP). L. A. Schmittroth and A. V. Grimaud (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 21, 1961. Contract AT(10-1)-205. 48p.

The mathematical methods used to derive the steady-state solution for the temperature distribution in a heterogeneous system are described, and the asymptotic case is considered. A program called Edit is given for determining when the solution is close to convergence after a number of iterations. The layout of the mesh for analysis of the heterogeneous system interfaces is described. Finally, the data preparative and operating procedures are given for obtaining the solution on the computer. An example of the use of the program is given as the solution to the problem of temperature distribution through a copper bucket full of molten lead. (D.L.C.)

23622 (NYO-9500) METHODS TO INCREASE BURNOUT HEAT TRANSFER. Annual Progress Report, September 1959-August 1960. Michael Markels, Jr., Robert L. Durfee, and Robert Richardson (Atlantic Research Corp., Alexandria, Va.). Sept. 30, 1960. Includes Translations: INTENSIFICATION OF HEAT TRANSFER IN THE CRITICAL AREA WITH THE AID OF ULTRASONICS. A. P. Ornatskii and V. K. Shcherbakov. THE INFLUENCE OF ENTRANCE CONDITIONS ON THE CRITICAL HEAT FLUXES DURING BOILING OF WATER IN TUBES. Z. L. Miropol'skii, M. E. Shitsman, I. L. Mostinskii, and A. A. Stavrovskii. Contract AF(30-1)-2404. 74p.

Acoustic energy generated by mechanical or electrical signals and its effect on pool boiling of isopropanol were studied. During the course of the investigation, a method was devised to determine the amount of heat-transfer surface wetted by the boiling isopropanol. Plots of heat flux versus temperature difference for each frequency showed that the acoustic energy did not significantly affect the

heat flux at burnout, but slightly increased the critical temperature difference. No general effect of frequency variation was found even at the frequencies of the "boiling songs" of isopropanol. The over-all effect of the acoustic energy was to disturb the vapor tending to coat the heat-transfer surface. This was most evident from the absence of film boiling even at temperature differences far above the critical temperature difference. The application of alternating current to the boiling system gives promise of a self-regulating method to increase boiling heat transfer when required, and is the most significant new finding of this investigation. Two pertinent Russian papers were translated and are appended. (auth)

23623 (ORNL-3079) HFIR HEAT-TRANSFER STUDIES OF TURBULENT WATER FLOW IN THIN RECTANGULAR CHANNELS. W. R. Gambill and R. D. Bundy (Oak Ridge National Lab., Tenn.). June 19, 1961. Contract W-7405-eng-26. 72p.

In support of the High Flux Isotope Reactor program, experimental determinations were made of friction factors, burnout heat fluxes, and average and local nonboiling heat-transfer coefficients for forced-convection flow of water through this aluminum and nickel rectangular channels under the following conditions: heat flux = 0.1×10^6 to 7.4×10^6 Btu/hr · ft^2, velocity = 10 to 85 fps, Reynolds number = 9,000 to 270,000, pressure = 1 to 39 atmospheres absolute, flow gap = 0.043 to 0.057 in., and heated length = 12 and 18 in. A few tests were made to ascertain the effect of an axially oriented cylindrical spacer strip on surface temperature distribution and burnout heat flux. The results of these studies, are in reasonably good agreement with accepted correlations. The friction factors are in satisfactory agreement with the Moody chart for the relative roughness of the test sections used, the burnout heat fluxes are well reproduced by the Soviet Zenkevich-Subbotin correlation, and the local and average heat-transfer coefficients are slightly larger than values predicted by the Hausen and Sieder-Tate equations. Miscellaneous experimental and analytical HFIR heat-transfer studies are included. (auth)

23624 (PIBAL-635) ON TURBULENT FREE MIXING OF PARALLEL STREAMS OF TWO DIFFERENT GASES. Shigeo Uchida (Brooklyn. Polytechnic Inst.). June 1961. Contract AF49(638)-217. 67p. (AFOSR-966)

A theoretical investigation of the turbulent mixing of two different nonreacting gases is presented. Four different equations for predicting the mixing are derived by considering combinations of two different formulations of the turbulent transport currents of mass, momentum and energy, and two different formulations of the eddy kinematic viscosity coefficient in compressible flow. All equations can be solved numerically to yield similar type solutions. The result of a numerical calculation comparing the solutions given by the four equations is presented. (auth)

23625 (TID-13088) BASIC EXPERIMENTAL STUDIES ON BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. Monthly Progress Report for Month of October 1960. B. Matzner (Columbia Univ., New York. Engineering Research Labs.). Oct. 31, 1960. Contract AT(30-3)-187. 9p. (MPR-X-10-60)

The loop was prepared for operation with the first 7-rod test section. Final fabrication and assembly work on this test section was continued. Parts of the second (spiral-wrapped) 7-rod test section were redesigned for maximum reliability. This redesign necessitated the purchase of new materials with a long delivery date. To accommoda e this change the schedule of tests for the second 7-rod test section was interchanged with the tests scheduled for an interim single rod test section. (auth)

23626 (TID-13104) PRESSURE DROP EXPERIMENTS OF UPPER AND LOWER DUMMY ASSEMBLIES FOR THE EXPERIMENTAL GAS COOLED REACTOR. SECTION V OF THE FUEL ASSEMBLY HEAT TRANSFER AND CHANNEL PRESSURE DROP EXPERIMENTS FOR THE EGCR RESEARCH AND DEVELOPMENT PROGRAM. T. J. McDonald and R. M. Higgins (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Nov. 30, 1960. Contract AT(10-1)-925, Mod. 9. 51p. (RD-0011)

The design arrangement of the Experimental Gas Cooled Reactor contains six fuel assemblies stacked vertically, above one another, in each of 232 vertical fuel channels in the graphite core. Each stack of six fuel assemblies is preceded and followed by a dummy assembly. The upper dummy assembly contains a reflector plug and a latch mechanism. The lower dummy assembly contains an orifice with an adjustable plunger capable of varying reactor coolant flow through the orifice. The pressure drop characteristics of the dummy assemblies for eight different throttling positions were obtained in the test program at near atmospheric pressure using an air flow corresponding to Reynolds Numbers of 12,000 to 60,000 in the fuel element assemblies. The data of the tests are presented in the form of velocity head coefficients expressed in terms of the highest velocity head of the two test locations involved for each coefficient. (auth)

23627 (WADD-TR-60-608) STUDIES OF TRANSIENT HEAT CONDUCTION AT HIGH THERMAL FLUX. H. Norman Abramson, Wen-Hwa Chu, and John C. Cook (Southwest Research Inst., San Antonio). July 31, 1960. Contract AF33(616)-6323. 78p.

The results are presented of a theoretical experimental study of transient heat conduction in cylindrical specimens of copper, Bakelite, stainless steel, and graphite, subjected to an incident thermal flux of approximately 500 cal/cm^2-sec. Theoretical investigations included the solution of the transient heat flow equation for cylindrical rods of finite length and with temperature dependent thermophysical properties. Comparisons of this theory, and similar theoretical approaches by other investigators, with experimental results show a large and consistent difference for all materials investigated. Although the experimental results are preliminary in nature and require further confirmation, the results obtained thus far indicate a serious inadequacy of present heat transfer theory for thermal fluxes of this order of magnitude, and the consistency of these results suggests that a considerably modified theory must be developed to achieve qualitative and quantitative agreement with experiment. (auth)

23628 (AEC-tr-4659) GENERALIZATIONS OF THE EXPERIMENTAL DATA FOR THE CIRCULATION OF WATER IN BOILERS. G. E. Kolodovskii (Kolodovsky). Translated by Gordon R. Love (Carnegie Inst. of Tech.) from Teploenergetika, No. 1, 3-29(1959). 38p.

A review of studies of water circulation was made to obtain a satisfactory generalization, correlating the working material, and the initial conditions, and using fundamental physical quantities, convenient for practical calculations of the relative difference between the theoretical and the true values describing the circulation process. It is concluded that losses in pressure caused by friction may be neglected for the calculation of circulation of vapor-water mixtures in tubes of 50-mm diameter and larger. A discussion is given of the incidental virtues which appear in the suggested generalization. (B.O.G.)

23629 (AEC-tr-4740) EFFECT OF UPSTREAM ELEMENTS ON CRITICAL BOILING IN A VAPOR GENERATING PIPE. M. A. Styrikovich, et al. Translated by Al Monks (Oak Ridge National Lab.) from Teploenergetika, 7: No. 5, 81-7(1960). 17p.

The experimental data compiled by various authors on critical thermal flow during the boiling of water in pipes are examined. The experimental results establishing the effect of the elastic properties of a medium in upstream volumes and of the magnitude of these volumes on the beginning of critical boiling in vapor generating pipes are clarified. (auth)

23630 (AEC-tr-4749) INVESTIGATIONS OF THE FLOW-DIFFUSION EFFECT. V. SEPARATION OF GAS MIXTURES BY FLOW DIFFUSION AS THE GAS-KINETIC REVERSAL EFFECT OF THERMODIFFUSION IN A COLD SEPARATING TUBE. Hans Tollert. Translated for (Oak Ridge National Lab.) from Z. Elektrochem., 61: No. 9, 1224-30(1957). 29p. (Includes Original 7p.).

The radial concentration shift in laminar flow of a gas mixture, the current diffusion effect, was found to be a gas-kinetic effect since it was possible to prove temperature displacements in a gas flow directed upwards and downwards. The concentration and temperature shifts were proved experimentally by means of a cold separating tube with two gas mixtures, carbon dioxide–hydrogen and air. (P.C.H.)

23631 (NP-tr-660) NOTE ON PROBLEM OF HEAT EXCHANGE IN A PIPE AT HIGH RATES ON AIR MOTION. G. V. Tsiklauri and V. V. Usanov. Translated from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., No. 11, 48-51(Nov. 1960). 6p.

The one-dimensional flow of a compressible gas in a smooth cylindrical pipe under the conditions of convection heat exchange with the wall was considered. The parameters of gas flow in any cross section of the pipe were determined. Experiments were carried out to verify the calculations. (M.C.G.)

23632 (NP-tr-675) APPROXIMATION METHOD OF CALCULATING THE EFFECT OF DIFFUSION UPON THE HEAT CONDUCTION OF GASES IN A BOUNDARY LAYER. R. Z. Alimov. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 3, 97-102(May-June 1960). 11p.

The effects of vapor diffusion of an adiabatic vaporizable liquid are considered with respect to the heat exchange between it and a surrounding hot gas. It is shown that the diffusion flow of a vaporizable substance with a direction opposed to heat flow, contributes to a decrease in heat exchange intensity in consequence of a decrease in the heat conduction coefficient of the boundary layer. (J.R.D.)

23633 (UCRL-Trans-677) ON THE PROBLEM OF HEAT EXCHANGE DURING LIQUID BOILING IN TUBES. I. P. Vishnev and N. K. Elukhin. Translated by Shewchuck Sergey for (Univ. of California. Lawrence Radiation Lab.) from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 3: 74-80(May 1960). 14p.

During the study of boiling in oxygen, the effect of geometrical dimensions of tubes on heat exchange was established. On the basis of theory of similarity, a criterial system was derived and a calculation formula proposed for determining heat exchange during boiling of different liquids inside of tubes. (auth)

23634 APPROXIMATE THEORY FOR FILM BOILING ON VERTICAL SURFACES. Y. Y. Hsu (N.A.S.A., Cleveland, Ohio) and J. W. Westwater. Chem. Eng. Progr., 56: Symposium Ser. No. 30, 15-24(1960).

A new equation is presented for film boiling at a vertical surface for saturated liquids in the absence of forced flow. The principal approximations are that vapor flow near the low end of the heating surface is viscous and Bromely's equation is valid there, turbulence develops where the local Reynolds number reaches about 100, and in the turbulent region of the heating surface thermal resistance is due entirely to the laminar sublayer. Tests with five liquids on tubes having lengths between 2 and 6.3 in., and a range of ΔT from 200° to 780°F., show that the equation is reliable to within an average error of about ±32%. (auth)

23635 HEAT TRANSFER IN SATURATED BOILING. Yan-Po Chang (Univ. of Notre Dame, Ind.) and N. W. Snyder. Chem. Eng. Progr., 56: Symposium Ser. No. 30, 25-38(1960).

Heat transfer by boiling liquid from a horizontal surface is described. The presence of vapor bubbles contributes three effects to the heat transfer: destruction of the wave motion adherent to natural convection; increase of the effective thermal conductivity due to the eddy motion, or agitation effect; and change of specific heat capacity due to change of phase, or latent heat effect. The agitation effect is assumed to extend to the whole regime of nucleate boiling; whereas the latent heat effect starts to become significant only when the condition corresponding to the peak heat flux is approached. Six-dimensional parameters are found from the equations of momentum and energy. An equivalent thermal diffusivity of boiling liquid is defined and correlated from these six parameters. A general equation of heat transfer coefficient is obtained in both convection and nucleate boiling. Peak heat flux and its corresponding temperature difference are determined according to the mechanism of agitation and latent heat transport. Calculated results agree well with test data of previous investigators for dependence on both temperature and pressure. (auth)

23636 POPULATION OF ACTIVE SITES IN NUCLEATE BOILING HEAT TRANSFER. R. F. Gaertner (General Electric Co., Schenectady, N. Y.) and J. W. Westwater. Chem. Eng. Progr., 56: Symposium Ser. No. 30, 39-48(1960).

Counts of active bubble-producing sites were determined throughout most of the nucleate region for a boiling liquid. An aqueous solution of nickel salts containing 20% solids was boiled at atmospheric pressure on a horizontal, flat, copper surface 2 in. in diameter in a 7½-in. vessel with no forced convection. The technique for determining active sites consisted of plating a thin layer of nickel on the copper surface during the boiling runs and subsequently counting the number of pin holes in the plate. The heat flux was varied from 7,680 to 535,000 Btu/(hr) (sq ft) and the Δt from 17.3° to 218.8°F. Counts of active sites were obtained from zero to a maximum of 1,130/sq in. at 317,000 Btu/(hr) (sq ft). A random geometrical distribution of active sites was revealed by a photographic study of the nickel-plated heated surface. For this system a linear relationship between the number of active sites and the heat flux, as suggested by Jakob, is nonexistent. The heat flux was proportional approximately to the square root of the number of sites. Widely known theoretical analyses for nucleate-boiling heat transfer do not include the functionality in the latter manner. (auth)

23637 THE EFFECT OF ELECTROLYTIC GAS EVOLUTION ON HEAT TRANSFER. F. O. Mixon, Jr. (E. I. du Pont de Nemours and Co., Inc., Wilmington, Del). Wang Yong Chon, and K. O. Beatty, Jr. Chem. Eng. Progr., 56: Symposium Ser. No. 30, 75-81(1960).

As part of a long-range study of the mechanism of heat

transfer in boiling, the effect of electrolytic bubble generation on the heat transfer coefficients between a horizontal copper surface and a pool of stagnant water was measured. The metal surface was pure copper about 2 in. by 2 in. and faced upward 10 in. below the liquid surface. Temperature of the block was varied by the use of electrical resistance heaters. Electrolysis was carried out by application of a direct current between the copper heating surface and a large anode located some distance from this surface. Small amounts of sodium hydroxide were added to the water to facilitate the electrolysis. The temperature of the heating surface was varied from room temperature up to 310°F, and the bath temperature was held approximately constant at 80° to 100°F. Electrolysis current was varied from 0 to 545 amp/sq ft. Material enhancement of heat transfer coefficients was noted with the electrolytically generated bubbles, when the surface temperature was both below and above the boiling point of water in the bath. Interpretation of the data is made with special reference to its contribution to heat transfer in the cooling of nuclear reactors where liquids may be subjected to surface temperatures in excess of their boiling points. (auth)

23638 A THEORY OF LOCAL-BOILING BURNOUT AND ITS APPLICATION TO EXISTING DATA. Louis Bernath (E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.). Chem. Eng. Progr., 56: Symposium Ser. No. 30, 95-116(1960).

A theory of local-boiling burnout is presented based on an analogy between the microconvective processes in local boiling and the conventional approach to turbulent diffusion processes. This theory describes, in a plausible manner, the physical significance of the mathematical relationships evolved in an empirical method of prediction of the burnout heat flux for water with local boiling over a wide range of experimental conditions. The prediction method is generalized to liquids other than water. Available data are assembled and discussed, and the results of the prediction method are compared with experimental values. (auth)

23639 RADIANT HEAT TRANSFER THROUGH THE ATMOSPHERE. Jin H. Chin (General Electric Co., Cincinnati) and S. W. Churchill. Chem. Eng. Progr., 56: Symposium Ser. No. 30, 117-27(1960).

The transmission of thermal radiation from plane-parallel and point sources above and spherical sources within the atmosphere is investigated theoretically. The atmosphere is idealized as a uniform plane-parallel dispersion of finite height situated above a diffusely reflecting surface. Expressions for the scattering and absorbing properties of the atmosphere are developed from the fundamental optical properties of the gas molecules and suspended materials. Analytical solutions for the transmission are derived by utilizing a two-component representation for the intensity with a second pair of components for the radiation reflected by the surface. These expressions and solutions have a variety of engineering applications. Illustrative calculations are presented for representative conditions. (auth)

23640 TEMPERATURE DISTRIBUTION IN SOLIDS WITH ELECTRICAL HEAT-GENERATION AND TEMPERATURE-DEPENDENT PROPERTIES. R. P. Stein and M. U. Gutstein (Columbia Univ., New York). Chem. Eng. Progr., 56: Symposium Ser. No. 30, 167-76(1960).

Computations of temperature distributions in solids of simple shape with internal heat generation produced by the passage of an electrical current through the solid become somewhat complicated when the temperature dependence of electrical conductivity must be taken into account. Analytical solutions are presented for a special case of temperature dependence which form the bases for developing simple criteria for determining when temperature dependence needs to be taken into account. It is shown that for nearly all metals temperature changes in the order of hundreds of degrees are required before significant effects of electrical-conductivity temperature dependence are realized. Also presented are convenient numerical procedures especially suitable for hand computation of temperature distributions when both electrical and thermal conductivity temperature dependences must be considered. The flat slab, cylindrical rod, and hollow cylinder are the shapes considered. (auth)

23641 ANALYTICAL STUDY OF HEAT TRANSFER RATES FOR PARALLEL FLOW OF LIQUID METALS THROUGH TUBE BUNDLES. PART I. O. E. Dwyer and P. S. Tu (Brookhaven National Lab., Upton, N. Y.). Chem. Eng. Progr., 56: Symposium Ser. No. 30, 183-93(1960).

Nusselt numbers were calculated for fully developed, turbulent, and parallel flow of liquid metals through staggered tube bundles by a method analogous to that of Lyon for flow of liquid metals inside circular tubes. The tubes were assumed to be arranged on an equilateral triangular pitch. A constant heat flux from the outer surfaces of the tubes was assumed, and the model of an annulus was used; i.e., the heat leaving each tube was assumed to be picked up by the flowing metal in an imaginary annulus surrounding the tube, the outer circumference of the annulus circumscribing an area equal to the total cross-sectional hexagonal area associated with each tube. The results were based on the velocity distribution data of Rothfus, Walker, and Whan for flow in concentric annuli. The effects on the Nusselt number of Prandtl number, Peclet number, tube diameter, pitch-to-diameter ratio, and the ratio of eddy diffusivity for heat transfer to that for momentum transfer were determined. (auth)

23642 HEAT TRANSFER TO A SINGLE COOLING TUBE IN A MOVING BED REACTOR. D. J. Loudin and K. O. Beatty, Jr. (North Carolina State Coll., Raleigh). Chem. Eng. Progr., 56: Symposium Ser. No. 30, 243-50 (1960).

Heat transfer to a single cooling tube placed across the diameter of a moving-bed column was measured during pilot plant reduction of uranium trioxide to uranium dioxide. Thermal resistance on the bed side of the cooling tube is approximately two thirds of over-all resistance between the bed and cooling air in the tube for zero air flow through the bed and is of the order of one fifth of over-all resistance with hot air flowing through the bed. Heat transfer coefficients on the bed side of the tube are severalfold greater than those which would be predicted for air flow past a single tube in the absence of solid particles. The heat transfer rate was not materially affected by the low solids velocities employed. The heat transfer studies were made in a $13\frac{1}{4}$-in. ID moving-bed column during countercurrent flow operation. Partially hydrated uranium trioxide pellets $\frac{1}{4}$ in. in diameter passed downward at approximately 2 ft/hr while hot air passed upward through the pellet bed at zero to about 1,200 lb/hr. Air metered at room temperature was passed through the $\frac{1}{2}$-in. stainless steel cooling tube at 50 to 100 ft/sec and heat transfer rates were determined from the inlet and outlet temperatures of the metered air stream. (auth)

23643 CONVECTIVE HEAT TRANSFER IN HORIZONTAL CYLINDER. G. F. Shaidurov (Perm State Univ. U.S.S.R.). Intern. J. Heat Mass Transfer, 2: 280-2(June 1961). (In English)

A stationary heat crossflow through a horizontal cylindrical cavity filled with water is investigated depending on the flow direction in a gravity field in the interval of Grashof's numbers ranging from 15 to 5×10^6. (auth)

23644 THE SURFACE BOILING BURNOUT IN A CHANNEL. Kinichi Torikai, Masao Hori, and Yoshihiro Ōuchi. J. At. Energy Soc. Japan, 3: 333-7(May 1961). (In Japanese)

The phenomena of surface boiling burnout were observed photographically. It is found that the burnout in a channel consists of either a stable flow or an unstable flow. The latter type occurs in the piston flow pattern in which the flow rate and wall temperature are unstable and oscillatory. Therefore, it is considered that the burnout heat flux in unstable flow is affected not only by the local condition of the channel but also by the system characteristics such as pumping power and flow resistance of the circulating system. The burnout heat flux in a circular channel is also measured at atmospheric pressure, and is correlated with the coolant velocity and subcooling. (auth)

23645 ON THE STABILITY OF HETEROGENEOUS SHEAR FLOWS. John W. Miles (Univ. of California, Los Angeles). J. Fluid Mech., 10: 496-508(June 1961).

Small perturbations of a parallel shear flow U(y) in an inviscid, incompressible fluid of variable density $\rho_0(y)$ are considered. It is deduced that dynamic instability of statically stable flows ($\rho_0'(y) < 0$) cannot be other than exponential, in consequence of which it suffices to consider spatially periodic, traveling waves. The general solution of the resulting differential equation is considered in some detail, with special emphasis on the Reynolds stress that transfers energy from the mean flow to the traveling wave. It is proved that sufficient conditions for stability are $U'(y) \neq 0$ and $J(y) > \frac{1}{4}$ throughout the flow, where $J(y) = -g\rho_0'(y)/\rho_0(y)U'^2(y)$ is the local Richardson number. It also is pointed out that the kinetic energy of a normal mode in an ideal fluid may be infinite if $0 < J(y_c) < \frac{1}{4}$, where $U(y_c)$ is the wave speed. (auth)

23646 NOTE ON A PAPER OF JOHN W. MILES. Louis N. Howard (Massachusetts Inst. of Tech., Cambridge). J. Fluid Mech., 10: 509-12(June 1961).

The theorem X established by Miles is given a simpler and more general proof. Some further theoretical results concerning the stability of heterogeneous shear flows are also presented, in particular a demonstration that the complex wave velocity of any unstable mode must lie in a certain semicircle. (auth)

23647 NOTE ON THE STABILITY OF PLANE PARALLEL FLOWS. D. H. Michael (Harvard Univ., [Cambridge, Mass.]). J. Fluid Mech., 10: 525-8(June 1961).

The behavior of three-dimensional small disturbances to plane parallel incompressible flows, which have a variation in the direction normal to the plane of mean flow, in relation to two-dimensional disturbances which vary in the plane of mean flow only is theoretically presented. The disturbances above the critical Reynolds number are defined, and a range is given for the upper end when it exists. (N.W.R.)

23648 BOILING LIQUID-METAL HEAT TRANSFER. W. R. Gambill and H. W. Hoffman. (Oak Ridge National Lab., Tenn.). [Paper No.] 1737-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 24p.

Nuclear reactors utilizing a boiling liquid metal as the heat carrier provide a method for satisfying the auxiliary-power requirements of a space vehicle at a minimum expenditure in weight. Fundamental heat-transfer data (in particular burnout limitations) needed for effective design are not available, and recourse must be made to estimations based on data for other fluids. Such predictions are evaluated as they apply to potassium and rubidium. It is concluded, in view of the wide disparity in the calculated peak-heat-flux values, that no reliable correlation exists. An additive technique that presupposes the independence of the boiling and convective heat-transfer mechanisms suggests that burnout flux levels with the liquid metals could be equivalent to those for water. Experiments on the subcooled boiling of water in swirl flow show that the peak heat flux is markedly increased over that attained with axial flow at the same pumping power. A similar advantage is indicated for potassium and rubidium. In a bulk-boiling system swirl flow should be particularly effective in maintaining a desirable wetted-wall condition. An experimental program for securing information on burnout fluxes with liquid metals is described. (auth)

23649 PUMPS FOR HIGH TEMPERATURE LIQUID SYSTEMS. H. W. Savage and A. G. Grindell (Oak Ridge National Lab., Tenn.). [Paper No.] 1743-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 29p.

High temperature pumps are required for several mobile and stationary nuclear reactor power plant applications using sodium, NaK alloy, or fused salt as coolants. Some of these pumps must operate at temperatures above 1500°F for periods well in excess of 20,000 hours. The incidence of failures is low. A summary and evaluation of the incentives, courses of development, present status, and applicability of the various types of pumps used in the past or now under development are given, which indicate design features that may be of use in developing equipment for space vehicles. The designs and special features of these pumps, primarily centrifugal pumps, are discussed. These features provide a descriptive background of the problems inherent in bearings, seals, lubrication, hydraulic performance, cavitation inception, choices of materials, fabrication procedures, drives, liquid expansion, and size and maintenance considerations. (auth)

23650 STRUCTURAL ASPECTS OF REACTOR AND HEAT EXCHANGER DESIGN. W. L. Greenstreet (Oak Ridge National Lab., Tenn.). [Paper No.] 1744-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 28p.

A discussion is given of basic aspects of operational behavior that must be examined for the design of a reactor component or a heat exchanger element. A discussion is given of design considerations for the temperature range in which creep of the material is important. When the deformation of a body exceeds a limiting value, failure, cracking, or complete separation of the material occur. Thermal cycling, cyclic growth, creep deformation and rupture, and buckling are considered. Specimens that fail through these mechanisms are described, and the basic materials properties required to predict the failures are discussed. The analytical or experimental methods used in investigating each phenomenon, with particular reference to specimens shown, are given. (auth)

23651 HEAT TRANSFER. Third National Heat Transfer Conference, held at the University of Connecticut, Storrs, August 9-12, 1959. Chemical Engineering Progress Symposium Series No. 30. Mario T. Cichelli, ed. New York, American Institute of Chemical Engineers. 303p.

Thirty papers are included; separate abstracts have been prepared for nine. Three papers were previously abstracted in NSA. The basic mechanisms and theorems along with computation and heat exchange equipment are covered. These discussions are presented to show the importance of exercising close control over the transfer of heat in mechanical, electrical, and chemical systems and more recently in nuclear and space technology. (N.W.R.)

23652 IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGERS. Norman Battle and Frederick Reginald Murray (Rolls-Royce, Ltd.). British Patent 867,869. May 10, 1961.

A heat exchanger is designed wherein the plates are substantially rectangular and have a length greater than their width. Each plate is formed to afford on one surface a series of parallel rib-like projections and intervening depressions and on the other surface coinciding parallel depressions and projections. The projections and depressions are straight and are arranged obliquely to the long axis of the plate. The plates are stacked so that the projections on one side of a plate contact and extend across those on the adjacent side of the next adjacent plate. The projections and depressions make a 45° angle to the long axis of the plate. Headers are provided adjacent to the ends of the plates to feed fluid to and collect fluid from the spaces between the plates, and supply pipes are connected with the headers and extend lengthwise and adjacent to the plates. A pair of ports is provided at each end of each plate, each port is aligned with other ports of the stack. The arrangement of the plates is such that one set of alternate spaces between the plates is open to one set of aligned ports at each end of the stack and the intervening spaces to the other set of aligned ports at each end of the stack. (N.W.R.)

23653 IMPROVEMENTS IN OR RELATING TO WATER COOLING TOWERS. Ronald Arthur Pearse (to United Kingdom Atomic Energy Authority). British Patent 870,485. June 14, 1961.

The design of a cooling tower for the removal of waste heat from water is described. The tower consists of an open ended upright shell supported on an open framework above a water catchment pond. The shell is made to have an outwardly curved lower end defining a flared inlet having a bounding surface continuous with the inner surface of the shell, whereby air flow through the shell under natural convection occupies substantially the whole of the cross section of the lower end of the shell. The catchment pond has a retaining wall having an inwardly curved upper end. (N.W.R.)

Instrumentation

23654 (AERE-R-3744) NAPHTHALENE DERIVATIVE SCINTILLATORS AND GLASS LOADING POSSIBILITIES. R. L. Macklin (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1961. 9p.

Naphthalene derivatives were found to provide a base for scintillators covering a range of refractive indices overlapping the lead optical glasses. Considerations are given indicating the feasibility of scintillation gamma detection of several times the stopping power of organic scintillators, utilizing glass powder. (auth)

23655 (ANL-6280) AN ULTRASONIC MEASUREMENT SYSTEM FOR THE PRECISE DETERMINATION OF THE ELASTIC MODULI OF SINGLE CRYSTALS. C. J. Renken (Argonne National Lab., Ill.). May 1961. Contract W-31-109-eng-38. 15p.

The measurement of the ultrasonic wave velocities in a sufficient number of known directions in a single crystal makes possible the direct computation of the elastic moduli of the crystal. For specimens having linear dimensions on the order of 2 to 3 mm, phase comparison techniques were found useful. The equipment described is based on the technique developed by McSkimin. The measurement system is actually a type of acoustic interferometer adapted to small solid specimens, and it requires specialized electronic equipment which cannot be purchased off the shelf. (auth)

23656 (ANL-6361) COUNTING METHODS FOR THE ASSAY OF RADIOACTIVE SAMPLES. Ellis P. Steinberg (Argonne National Lab., Ill.). May 1961. Contract W-31-109-eng-38. 72p. This report supersedes ANL-5622.

A guide is presented for problems involved in counting methods and techniques used in avoiding or correcting them. Beta, alpha, and gamma counting is treated. Among the items discussed are the geometry factor, absorption, scattering, and background. A bibliography of 164 references is included. (D.L.C.)

23657 (BNL-5493) A HIGH RESOLUTION DIFFERENTIAL ČERENKOV COUNTER. Thaddeus F. Kycia and Edgar W. Jenkins (Brookhaven National Lab., Upton, N. Y.). [1961?]. 15p.

A high-resolution differential Čerenkov counter is described which has a velocity selection range of $0.98 < \beta < 1$, has a counting efficiency of 90%, and is capable of distinguishing K mesons from π mesons at momenta as high as 20 Bev/c for a velocity difference $\Delta\beta$ of 2.8×10^{-4}. The anticoincidence feature and resolution of the counter are discussed. The performance of the counter with various beams in the Alternating Gradient Synchrontron is described. (D.L.C.)

23658 (DASA-1202) STUDY OF NEUTRON-ELECTRON MULTIPLIERS. Final Report. (Hughes Aircraft Co., Culver City, Calif.). Feb. 17, 1961. 66p. (AD-252021)

Research on a neutron-electron multiplier is outlined. A satisfactory dynode structure with MgO surfaces was developed for high-temperature use up to 400°C. Some methods of preparing thin films are described. It is concluded that, in order to develop a useful neutron-electron multiplier, studies of electron emission due to incident heavy particles are needed. (D.L.C.)

23659 (DP-544) A WALK-THROUGH MONITOR FOR BETA-GAMMA SHOE CONTAMINATION. Harold V. Hardison (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Jan. 1961. Contract AT(07-2)-1. 8p.

A sensitive "walk-through" monitor was developed to detect beta-gamma contamination on the shoes of personnel exiting from a regulated area. The monitor is continuously compensated for changes in general background radiation; consequently it can detect as little as 100 cpm of beta-gamma contamination, even within the range of extraneous variable sources of radiation. (auth)

23660 (JEN-61) DETECCION DE PARTICULAS ALFA POR MEDIO DE PANTALLAS DE SULFURO DE CINC. ESTUDIE DE SUS CARACTERISTICAS. Rafael Gaeta and Francisco Manero (Spain. Junta de Energia Nuclear, Madrid). 1959. 16p.

A method of ZnS(Ag) screen preparation for detecting alpha particles is described. The behavior of the luminophore in a scintillometer is primarily studied and followed

by experimental methods in the preparation of screens with the specific qualities required. A sedimentation technique of ZnS(Ag) deposition was employed and followed by hot pressing. The variation of impulse size with the thickness of luminophore was studied, and a maximum value of 6.5 mg/cm^2 in unpressed screens and 6 mg/cm^2 in the pressed ones was found. The "plateau" curves present flat areas up to 450 volts. The background in the absence of a source is below 0.5 impulse/minute. The mechanical qualities of stability during long times of operation and moderate resistance to abrasion are excellent. (auth)

23661 (LAMS-2526(p.133-50)) PROGRESS REPORT ON LASL HUMAN COUNTER (HUMCO II). E. C. Anderson, R. L. Schuch, and V. N. Kerr (Los Alamos Scientific Lab., N. Mex.).

Results are reported from performance tests on Humco II, a 4π whole-body γ detector employing liquid scintillation detectors. The resolving power of Humco II for some nuclides of interest for medical tracer studies and for contamination monitoring was investigated. Data are tabulated. Results are included from energy calibrations. (C.H.)

23662 (LAMS-2526(p.151-63)) TESTING OF MULTIPLIER PHOTOTUBES FOR HUMCO II. E. C. Anderson (Los Alamos Scientific Lab., N. Mex.).

Procedures are described which were used for testing photomultiplier tubes for use in Humco II, a large liquid scintillation counter for whole-body measurements of γ radioactivity. (C.H.)

23663 (LAMS-2526(p.186-96)) MOONSPEC: DESIGN OF DETECTOR FOR MEASUREMENT OF RADIOACTIVITY OF LUNAR SURFACE. M. A. Van Dilla, R. L. Schuch, and E. C. Anderson (Los Alamos Scientific Lab., N. Mex.).

Design features and circuits are described and illustrated for a phoswich γ radiation detector for measuring the radioactivity of the lunar surface. The unit consists of an Al can containing the phoswich, photomultiplier, and circuitry necessary to develop signal and rejection pulses fixed in polyurethane foam. The detector performed well in laboratory tests. (C.H.)

23664 (LAMS-2526(p.197-201)) ON THE RADIOACTIVITY OF CESIUM IODIDE (THALLIUM) SCINTILLATION CRYSTALS. M. A. Van Dilla (Los Alamos Scientific Lab., N. Mex.).

Both Cs^{137} and Cs^{134} radioactivity was found in 3 CsI(Tl) scintillation crystals. The gamma spectrum was measured. Possible origin of the radioactivity is discussed. (C.H.)

23665 (LAMS-2526(p.218-21)) NEUTRON RESPONSE OF TRICHLOROETHYLENE-SATURATED WATER TETRACHLOROETHYLENE CHEMICAL DOSIMETERS. D. G. Ott, J. A. Sayeg, and P. S. Harris (Los Alamos Scientific Lab., N. Mex.).

Two chlorinated ethylene systems, which contained varying amounts of water, were compared in their response to fast neutrons. Data are presented graphically. Applications of chemical dosimeters for measurement of the individual contributions of different radiations in a mixed radiation field are discussed. (C.H.)

23666 (LAMS-2526(p.325-34)) BODY SODIUM^{24} MEASUREMENT FOR PERSONNEL MONITORING AND CASUALTY ASSESSMENT. E. R. Ballinger and P. S. Harris (Los Alamos Scientific Lab., N. Mex.).

Design and performance testing are described for a neutron-induced, body Na^{24} activity detector for personnel monitoring and casualty assessment. A Pb-enclosed NaI scintillator-photomultiplier tube probe is connected by shielded cable to a power supply, amplifier, and rate meter unit with controls. The meter is scaled in rads of 1.5-Mev neutrons required to produce the Na^{24} activity observed when the probe is applied to the lumbar area of the back of the individual being monitored. The controls permit a 2-scale range, from 1 to 100 rads and from 1 to 1000 rads, and an adjustment to compensate for background activity up to ±5 mr/hr. (C.H.)

23667 (LAMS-2526(p.346-54)) CHARACTERISTICS OF THE LARGE H-4 FISSION GAMMA COUNTER. J. A. Sayeg, J. H. Larkins, and E. L. Carr (Los Alamos Scientific Lab., N. Mex.).

Modifications in the design of a large H-4 fission γ counter are described. The unit consists of 2 opposing 4-in.-diameter, 2-in.-thick, sodium iodide crystals shielded by a truncated $\frac{5}{8}$-in.-thick lead absorber to reduce the natural background of the foils used. Each crystal is connected to a DuMont No. 6363 3-in. photomultiplier tube. The entire assembly is shielded by approximately 4 in. of lead. The output of each photomultiplier is connected to a common Model 250N preamplifier, thence to a Model 250 amplifier, a Model 120 dual channel analyzer, and finally to 2 Model 775 scalers. These electronic components provide a means of counting simultaneously at 2 different threshold counting bias values, thus permitting twice the data to be obtained in the same counting time. A schematic sketch and calibration data are included. (C.H.)

23668 (NASA-TN-D-1035) TWO INSTRUMENTS FOR MEASURING DISTRIBUTIONS OF LOW-ENERGY CHARGED PARTICLES IN SPACE. Michel Bader, Thomas B. Fryer, and Fred C. Witteborn (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.). July 1961. 42p.

Current estimates indicate that the bulk of interplanetary gas consists of protons with energies between 0 and 20 kev and concentrations of 1 to 10^5 particles per cm^3. Methods and instrumentation for measuring the energy and density distribution of such a gas are considered from the standpoint of suitability for space vehicle payloads. It is concluded that electrostatic analysis of the energy distribution can provide sufficient information in initial experiments. Both magnetic and electrostatic analyzers should eventually be used. Several instruments designed and constructed for space plasma measurements, and the methods of calibration and data reduction are described. In particular, the instrument designed for operation on solar cell power has the following characteristics: weight, 1.1 pounds; size, 2 by 3 by 4 inches; and power consumption, 145 Mw. The instrument is designed to yield information on the concentration, energy distribution, and the anisotropy of ion trajectories in the 0.2 to 20 kev range. (auth)

23669 (NP-10391) A METHOD TO DETERMINE ELECTROMAGNETIC COUPLING TO ORDNANCE DEVICES ABOARD SHIPS. William T. Dickinson (Jánsky & Bailey, Alexandria, Va.). June 15, 1961. Contract N178-7604. 12p.

A method is presented which permits the measurement of mutual impedance between electroexplosive devices and radio, radar, or other radiofrequency generators aboard ship. The method does not require the radio or radar set to be in operation. Only one measurement is required (at each frequency). The method offers certain advantages over GO-NO-GO and instrumented HERO tests. (auth)

23670 (RISO-24) INFLUENCE OF THE GAMMA BACKGROUND ON THE MEASUREMENT RANGES OF NEUTRON DETECTORS IN THE TANK TYPE REACTOR, DR 2. Jens Rasmussen and Ole Walmod-Larsen (Denmark.

Atomenergikommissionen. Forsøgsinstitut, Risø). May 1961. 12p.

The measurements taken in order to find the influence of the gamma background on the multi-range neutron detectors in DR 2 are described. It was found that reliable neutron detection was not possible in a sufficient flux range. Improvement of the measuring conditions was then obtained by shielding the detectors against gamma radiation by means of lead covers placed around the instrument thimbles in the reactor tank. After different runs at 5 Mw, checks were made, and the improvements were found satisfactory. (auth)

23671 (SC-4274(FT)) FIELD TEST SERIES, OPERATION AND MAINTENANCE INSTRUCTIONS [ON] ME-16 TELESCOPE. (Sandia Corp., Albuquerque, N. Mex.). Mar. 1961. 168p.

Instructions for the operation and maintenance of the ME-16 Tracking Telescope are provided. The mechanical, hydraulic, electrical, and optical assemblies which are integral components of, or mount on, the telescope tube, stand, turret, and hydraulic pump unit are covered. A description of the ME-16 telescope and its capabilities is given. Principles of operation, operating instructions, preventive maintenance, adjustments, troubleshooting, repair, and operation and maintenance of the mobile mount are discussed. (M.C.G.)

23672 (SCDR-78-61) MEASUREMENT OF FREE SURFACE MOTION BY THE SLANTED RESISTOR TECHNIQUE. L. M. Barker (Sandia Corp., Albuquerque, N. Mex.). May 1961. 19p.

A method is being developed for observing the motion of a free surface immediately following the arrival of a shock wave. The method uses the electrical signal produced by the shorting of a resistance wire placed close to the free surface. The experimental configuration is described. (auth)

23673 (SCR-250) GRID BLACKOUT IN VACUUM TUBES. K. D. Hardin (Sandia Corp., Albuquerque, N. Mex.). June 1961. 25p.

A method which gives quantitative data is presented which allows for characterization of the grid blackout effect and is applicable to calculation of circuit degradation. Data are presented for several tube types which show developed bias and discharge time constants as a function of pulse input conditions. Blackout can seriously change the performance of any vacuum tube circuit which utilizes the tube in positive grid operation. The effects on CW oscillators and UHF mixers are discussed. An equivalent circuit which simulates some portions of the blackout phenomenon is presented and used to calculate effective capacitance and resistance associated with the grid surface. (auth)

23674 (TID-12824) METAL SHEATHED, REFRACTORY INSULATED THERMOCOUPLE FOR NUCLEAR REACTOR. Specification No. TT-1. R. T. Wiseman and T. Baumbarger (Kaiser Engineers. Div. of Henry J. Kaiser Co., Oakland, Calif.). July 19, 1960. 51p.

There may be further revisions and addenda issued to this specification.

The specification covers furnishing, testing, delivery, quantities, and lengths of continuous, metal-sheathed thermocouples, each consisting of an ungrounded hot junction and two conducting wires surrounded by tightly compressed refractory insulation for use in the EGCR. All thermocouples which terminate inside or on the reactor vessel are included. (B.O.G.)

23675 (TID-13191) PRECISION LATTICE PARAMETER DETERMINATION BY DOUBLE-SCANNING DIFFRACTOMETRY. H. W. King and L. F. Vassamillet (Mellon Inst., Pittsburgh). 1961. 18p.

The availability of counter-tube diffractometers which can scan both sides of the direct beam enables the zero angle position to be located by comparing peak positions measured on either side of the beam. These diffractometers may thus be used to determine accurate lattice parameters without the need of a calibrating substance. The possibility of this method is explored by determining the lattice parameter of pure Ag, and the limits of accuracy are discussed. (auth)

23676 (WADD-TR-60-565) CERAMIC TUBES DEVELOPED FOR EXTERNAL HEAT SOURCES. John F. Richter (Eitel-McCullough, Inc., San Carlos, Calif.). Sept. 20, 1960. Contract AF33(600)-39665. 43p. (PB-171492)

The material, design, and processing problems associated with the development of an electron tube structure capable of sustained operation by means of an external radioisotope heat source are discussed. The adaptation of an existing ceramic-metal, planar structure for use with an existing Po^{210} heat source in a proof-of-principle device is described, and performance of this device during and after its successful demonstration is reported. The limitations of the planar structure are discussed and design experiments utilizing a cylindrical structure with an electroformed cathode, are described. Affirmative conclusions were drawn as to the feasibility of the cylindrical structure. On this basis, recommendation is made to utilize the cylindrical structure as the basis for development of a practical tube. (auth)

23677 (AEC-tr-4738) FAST NEUTRON SPECTROMETER USING LITHIUM-6 AND SILICIUM DIODES. J. Bok, B. de Cosnac, J. P. Noel, and R. Schuttler (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Fontenay-aux-Roses). May 1961. 19p. (DEP/SEPP No. 157/61)

A spectrometer was designed for neutrons and consists of two surface barrier diodes, on one of which Li^6F is deposited by vacuum evaporation. The theoretical basis of its resolution is discussed. The performance obtained with thermal and fast neutrons is given. (D.L.C.)

23678 (AEC-tr-4746) VACUUM HIGH-TEMPERATURE CAMERA FOR X-RAY DIFFRACTION ANALYSIS. V. I. Prokhvatilov and E. I. Gindin. Translated by Helen Chick and Roy G. Merryman (Los Alamos Scientific Lab.) from Zavodskaya Lab., 16: 965(1950). 3p.

An x-ray camera for the precise determination of crystal lattice parameters by the method of back reflection was designed for use at temperatures up to 500°. Its operation is described. (D.L.C.)

23679 (CEA-tr-A-904) DESCRIPTION PROVISOIRE ET MODE D'UTILISATION D'UN APPAREIL POUR LA MESURE DU DEUTÉRIUM DANS L'HÉLIUM PAR LE PROCÉDÉ DE CONDUCTIBILITÉ THERMIQUE. (Provisional Description and Method of Utilization of Apparatus for Measurement of Deuterium in Helium by Thermal Conductivity Method). Translated into French from the German review: "Apparatus for the Measurement of Deuterium in Helium." [nd]. 18p.

An apparatus for the measurement of ≤4% deuterium in helium, based on differences in thermal conductivity, is described. In order to obtain a sufficient variation in the thermal conductivity, the deuterium in heavy water is combined with oxygen in a combustion chamber. A sketch of the apparatus is given, and the steps preliminary to its operation are outlined. (J.S.R.)

23680 (CEA-tr-A-920) MISE EN EVIDENCE DES NEUTRONS AVEC UN ELEMENT P-N DE PHOSPHURE D'INDIUM. (Detection of Neutrons with p-n Elements in Indium Phosphors). R. Gremmelmaier and H. Walker. Translated into French from Z. Naturforsch., 11a: 420-2 (1956). 8p.

As an introduction to the study of the effects of slow neutron irradiation of indium phosphide p-n elements, the neutron-induced perturbation centers in semiconductors are discussed. The nuclear reactions induced in indium by thermal neutrons are tabulated. The no-load voltage of the irradiated crystal was measured, and the source of this voltage is discussed. (J.S.R.)

23681 (CEA-tr-A-933) APPAREIL DE CONTROLE DE LA RADIOACTIVITE DANS DES VOLUMES DETERMINES D'EAU OU D'AIR AU REPOS OU EN MOUVEMENT. (Apparatus for Checking Radioactivity of Given Volumes of Water or Air at Rest or in Motion). R. Plesch. Translated into French from German Patent No. 1067536. Feb. 13, 1958. 10p.

An apparatus for the separate measurement of β and γ activity in a given volume of air or water at rest or in motion is described. A detector sensitive only to γ rays is surrounded by several other detectors, sensitive predominantly to β particles. A scintillator crystal joined to a photomultiplier is used as γ detector and thin-walled tube counters are used for β detection. The scintillator is surrounded by a shield absorbing the β rays. The complete ensemble is enclosed and the reading of the two detector systems will give separately the β and γ activity. A sketch of the apparatus and typical results are given. (J.S.R.)

23682 (CEA-tr-X-292) RESPONSE D'UN PLASTIQUE A SCINTILLATIONS POUR PARTICULES CHARGEES. (Response of a Plastic Scintillator to Charged Particles). M. A. Vigon Sanchez, J. Montes Ponce de Leon, C. E. Granados Gonzalez, and R. Gutierrez Bernal. Translated into French from Anales real soc. espan. fis. y quim. Ser. A (Madrid), 54A: Nos. 3/4, 91-2(1958). 5p.

The response of a plastic scintillator to protons with energies between 0.2 and 1.7 Mev was determined. If, for each proton energy, the pulse height is represented with respect to the number of pulses, a gaussian distribution is obtained. From the distributions corresponding to each energy, the most probable height of the pulses and the variation of this value are determined. By representing the proton energies with respect to the most probable amplitudes, the response curve of the plastic for different energies is obtained, and this curve is shown. (tr-auth)

23683 (NP-tr-691) A 1000-CHANNEL TIME-OF-FLIGHT SELECTOR. J. Apter, J. Roussel, J. M. Tissier, and R. Wahl. Translated by J. B. Sykes for U.K.A.E.A. Atomic Energy Research Establishment from Nuclear Instr. & Methods, 5: 300-11(1959). 30p. (Handwritten MS. copy).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 5366.

23684 (SCL-T-370) EXCERPTS FROM THE ELECTROSTATIC ELECTRON ULTRAMICROSCOPE. H. Mahl. Translated by Marcel I. Weinreich for Sandia Corp. from Jahrb. AEG-Forsch., 7: No. 1, 43-56(Mar. 1940). 15p.

An electrostatic electron ultramicroscope was developed. The geometric configuration of the rays' trajectory was similar to the course of the rays in the two-stage projection light microscope. Single lenses with a negative center electrode were chosen for the ultramicroscope. The dependence of the focal length on the diaphragm's diameter of the center electrode, in the case of a definite arrangement of electrodes, was determined. The quality of the image projection was not affected by the order in which the carrier foil or the object was irradiated. The lens electrode did lead to interferences and disturbances because it had to be shifted horizontally for the purpose of adjusting the image field. The accompanying deformation of the lens field appeared as a fluctuating astigmatic faulty delineation of the image. The final magnification of the image was chosen in the multiples of 9000:1. The electrons serving to illuminate the object were emitted from an incandescent wire. A magnetic shielding was installed in the interior of the tube. (M.C.G.)

23685 (UCRL-Trans-452) AN INVESTIGATION INTO THE PROCESS OF RECRYSTALLIZATION OF GRAINS OF HALOIDAL SILVER IN EMULSIONS FOR NUCLEAR RESEARCH. V. M. Uvarova, M. F. Rodicheva, and K. H. Romanovskaia. Translated by I. R. Titunik from Trudy Vsesoyuz. Nauch.-Issledovate. Kinafototoinst., No. 11, (21), 17-29(1957). 28p. (Includes original, 13p.).

The causes of recrystallization of microcrystals in nuclear emulsions were investigated. The effects of substances such as bromide, urea, soda, ammonia, rhodamide, and methyloxytriazoindolizine on the colloidal stability in these systems were studied. It was concluded the strength of adsorption gelatin coatings on the grains of haloid silver and the strength of the structural grid of the gelatin molecules of nuclear emulsions are insufficiently high. (J.R.D.)

23686 (UCRL-Trans-453) A STUDY ON THE CAUSES OF APPEARANCE OF DICHROIC (COLORED) FOG AND BLACK FILM OCCURRING IN THE PROCESS OF DEVELOPING THICK-LAYERED NUCLEAR PLATES. V. M. Uvarova and M. F. Rodicheva. Translated from Trudy Vsesoyuz. Nauch.-Issledovate. Kinafototoinst., No. 11, (21), 30-5(1957). 15p. (Includes original, 6p.)

The dependence of dichroic fog density on the sulfite concentration in the developer and on the temperature of dry stage development of thick-layered nuclear films was studied. Resulting data indicate that emulsion layers of 200 to 400 μ in thickness should be developed in low sulfite Amidol with a pH not exceeding 6.7. The temperature of the dry stage should not be higher than 24°C. (J.R.D.)

23687 (UCRL-Trans-454) A STUDY OF THE SULFATE PRECIPITATION PROCESS OF NUCLEAR EMULSIONS. V. M. Uvarova, M. Yu. Deberdeev, and E. I. Scherbakova. Translated from Trudy Vsesoyuz. Nauch.-Issledovate. Kinafototoinst., No. 11, (21), 36-42(1957). 19p. (Includes original, 7p.).

A study of sulfate precipitation processes in nuclear emulsions was conducted by examining concentrated thin non-single-layered preparations of the coagulum at various development stages. The study results indicate that a method of sulfate precipitation and coagulum dispersion which ensures sufficient peptization of the coagulum is desirable. The method may lead to preparation of thick-layered photo plates without substantial loss of sensitivity during drying and storage. (J.R.D.)

23688 A NEUTRON DETECTOR SYSTEM FOR PULSED ACCELERATORS. G. Moscati and J. Goldemberg (Universidade, Sao Paulo, Brazil). Anais acad. brasil. cienc., 33: No. 1, 25-9(1961). (In Portuguese)

An energy independent neutron detector to be used with pulsed photoneutron sources is described. The system is sensitive only between bursts. Details are given of the geometry, the electronics, and some results obtained with a 22 Mev Betatron. (auth)

23689 A SEMICONDUCTOR PULSE COUNTER. A. Ambroziak (Inst. of Fundamental Technical Problems, Polish Academy of Sciences, [Warsaw]). Bull. acad. polon. sci. Sér. sci. tech., 9: 179-83(1961). (In English)

A semiconductor pulse counter utilizing the decimal system consists of an n-type semiconductor bar with a nonrectifying contact at either end. Between these contacts are 10 p-n junctions. A bias d-c voltage is applied across the contacts, setting up a linear potential distribution in the bar. The voltage current characteristic measured between the negatively biased contact and each of the p-n junctions is typical of the double base diode and presents a segment with negative resistance. This characteristic admits the work of a junction in two stable states: in the reverse state of very high resistance, or in the conducting state of very low resistance. (L.N.N.)

23690 THE SEALING OF GLASS VIEWING PORTS IN LIQUID HYDROGEN BUBBLE CHAMBERS. V. A. Beketov, Ya. M. Selektor, S. M. Zombkovskii, and M. S. Ainutdinov. Cryogenics, 1: 237(June 1961).

Experiments using PTFE, squeezed in an enclosed space, were carried out in order to produce a reliable seal which could be used many times. The seal that gave the best results is diagrammed. (P.C.H.)

23691 PROSPECTS OF SEMICONDUCTOR RADIATION DETECTORS. G. Fabri (Laboratori CISE, Segrate, Italy). Energia nucleare (Milan), 8: 337-41(May 1961). (In Italian)

Germanium and silicon have been used as radiation detectors, their electrical properties being highly sensitive to nuclear particles. Whenever a charged particle penetrates a semiconductor it creates electrons and holes, which can be collected in the presence of an electric field. In a reversed bias junction this process allows the detection of ionizing particles. An analysis of different methods to produce surface junction is carried out. Experimental results of energy resolutions in semiconductor detectors are more satisfactory than the ones available with ionization chambers. (auth)

23692 TEN-CHANNEL RADIATION MONITOR FOR PULSED ACCELERATORS. W. Higinbotham, E. Rainey, and J. Chester (Brookhaven National Lab., Upton, N. Y.). Health Phys., 5: 169-72(June 1961). (BNL-4978)

A monitoring system utilizing 5-1 polyethylene ionization chambers was installed at ten locations in the Cosmotron building. The current which flows in an ionization chamber during an accelerator pulse is integrated by an electrometer circuit. The resulting signal is displayed locally, at the accelerator console, and is recorded on a strip chart. A timing circuit controls the recorders and resets the integrators just before each accelerator pulse. The total dose over an arbitrary period of time is displayed digitally on a scaler for each detector. Full scale corresponds to 70 μr on a single Cosmotron pulse, or to an average rate of 500 mrems/hr. The circuits are sensitive to 0.1% of the full-scale value. (auth)

23693 HIGH SENSITIVITY SILVER-ACTIVATED PHOSPHATE GLASS FOR THE SIMULTANEOUS MEASUREMENTS OF THERMAL NEUTRONS, γ- AND/OR β-RAYS. Ryosuke Yokota (Tokyo Shibaura Electric Co., Kawasaki, Japan), Saburo Nakajima, and Eiji Sakai. Health Phys., 5: 219-24(June 1961).

A new silver-activated phosphate glass which contains a large amount of Li and a small amount of B was prepared. The glass has greater sensitivity for thermal neutrons, is less energy-dependent, and can be prepared to have lower predose reading than the Al–Ba–K–Ag metaphosphate glass. By exposing three pieces of glass covered by brass plate, cadmium plate, and Al foil, respectively, any mixed radiation dose of thermal neutrons, γ rays, and β rays can be measured separately and simultaneously. An integrated dose of 50 mr for γ rays and 8×10^6 n_t/cm^2 can be measured with an accuracy of ±5%, and 0.1 r or 1.6×10^7 n_t/cm^2 with an accuracy of ±3%. (auth)

23694 A FAST NEUTRON SPECTROMETER WITH ONE DATA UNIT. Yu. A. Egorov and Yu. V. Pankratev. Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: No. 6, 112-15(June 1961). (In Russian)

A crystal of stilbene irradiated by neutrons and γ rays creates pulses of different forms, so that pulses of neutrons can be distinguished on a background of pulses of γ rays. Using this fact, a fast neutron scintillation spectrometer is made which is not sensitive to a γ background when irradiated by neutrons with an energy of $E_n > 2$ Mev. The spectrum of the source Po + Be is measured. (tr-auth)

23695 THE DETERMINATION OF AVERAGE LENGTH OF RUN OF β PARTICLES IN THE WORKING SECTION OF AN IONIZATION CHAMBER. A. N. Slatinskii (Central Scientific-Research Inst. of Cotton Industry, Moscow). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: No. 6, 135-7(June 1961). (In Russian)

A formula is obtained for the calculation of the range of beta particles in the rectangular section of an ionization chamber depending on its dimensions and distance from the source. (tr-auth)

23696 LOCAL QUANTUM EFFICIENCY IN COUNTER TUBES. II. EXPERIMENTAL RESULTS. Tatsusaburo Suzuki (Japan Defense Agency). J. At. Energy Soc. Japan, 3: 329-32(May 1961). (In English)

Local quantum efficiencies in Geiger counter tubes are measured by means of a thin sheet of gamma-rays passed through a heavy metal gamma-ray slit. The experimental results are compared with computed results. The local efficiency greatly depends upon the angle between the incident direction of the gamma-rays and the inner surface of the counter. The maximum value of the local efficiencies depends upon the inner diameter of the counter. (auth)

23697 CHEMICAL INSTRUMENTATION. 13. NUCLEAR RADIATION ELECTRONIC GEAR. S. Z. Lewin (New York Univ., New York). J. Chem. Educ., 38: A457-8; A460; A462; A464; A467-8; A470-1; A474; A476-7; A479-80; A482(July 1961).

A survey of the basic principles, characteristics, and limitations of important chemical instruments is reported. The emphasis is on commercially available equipment, and approximate prices are quoted to show the order of magnitude of costs of the various types of design and construction. (P.C.H.)

23698 SINGLE CRYSTAL GAMMA-RAY SCINTILLATION SPECTROMETER. Tahir Husain (Government Coll., Lahore). J. Nat. Sciences and Math., 1: 1-15(Apr. 1961). (In English)

A single crystal gamma-ray scintillation spectrometer is described. A technique for polishing and mounting the NaI(Tl) crystal is used that improves the resolution. (auth)

23699 THREE CRYSTAL GAMMA-RAY SCINTILLATION PAIR SPECTROMETER. Tahir Husain (Government Coll., Lahore). J. Nat. Sciences and Math., 1: 16-33(Apr. 1961). (In English)

A scintillation pair spectrometer is described. In order to improve the resolution, differential discriminators are incorporated in each side channel of the spectrometer. (auth)

23700 BEAM BROADENING BY AN AMPLITUDE SELECTOR. P. Moatti. J. phys. radium, 22: 225-9(Apr. 1961). (In French)

The broadening of an energy spectrum is studied by summing the channels of an amplitude selector. The case of the deformation of a Gaussian curve when it is built with rectangular steps is emphasized. Characteristics of the original Gaussian curve are given from the experimental one. Application to the study of gain fluctuations of a photomultiplier is considered. (auth)

23701 HIGH FREQUENCY ELECTRIC EXCITATION ION SOURCES. Daniel Blanc and André Degeilh (C.N.R.S., Touolouse, France). J. phys. radium, 22: 230-46(Apr. 1961). (In French)

Sources excited by high frequency oscillators (or h-f sources) give high currents of positive ions, and are of current use in particle accelerators, ion microscopes, and thermonuclear apparatus. Producing nearly monoenergetic ions, they are of value for mass spectroscopy. The papers about them, rather numerous, are related to very different matters, so that the data on these sources are found often in a more general study. This rather varied material was collected in order to state the conditions of practical use of the sources. After describing the usual models of h-f sources, they are classed according to the mechanism of the discharge (annular and linear, with or without addition of a constant magnetic field). Then, the problem of ion extraction; principal extraction systems and parameters influencing the intensity of the extracted stream. Finally, the average ion energy and the dispersion around this average value are given. (auth)

23702 ERROR ESTIMATION FOR THE ABSOLUTE MEASUREMENT OF RADIOACTIVE PREPARATIONS BY THE COINCIDENCE METHOD. K. W. Helbig (Zentralinstitut fur Kernphysik, Rossendorf, Ger.). Kernenergie, 4: 291-2(Apr. 1961). (In German)

A method is developed for the estimation of the relative error, as a function of the decay rate, in the absolute measurement of radiation by the coincidence method. An example of the utilization of the method is given. (J.S.R.)

23703 PARTICLE DISCRIMINATION WITH SCINTILLATION COUNTERS. M. Bormann, R. Langkau, G. Lindström, H. Neuert, and J. Warncke (Physikalisches Staatsinstitut, Hamburg). Nukleonik, 3: 85-92(May 1961). (In German)

Recent investigations on a series of scintillation crystals have shown that in many scintillators differences in the decay time of scintillations occur according to the particle (α particles, protons, or electrons) which releases the scintillation. In many cases the differences are so considerable that the scintillation pulses can be sorted according to their origin. Information is given on the present state of the investigations on these phenomena. The methods used for practical application in the field of nuclear physical measurement techniques are discussed. 25 references. (tr-auth)

23704 IMPROVEMENTS OF THE IMAGE OF ARTIFICIALLY RADIOACTIVE ORGANS BY MEANS OF A DISCRIMINATING CIRCUIT. E. Marzano. Nuntius Radiol., 27: 296-303(1961).

A description is presented of a discriminating circuit, which, used in the scanning of a "radioactive picture" produced by body organs containing Au^{198} or I^{131}, considerably eliminates background noise. The principle of the circuit, based on Friedell's circuit is that variations in frequency are transformed into variations in amplitude. A simple diode cut-off system can then be used. (EURATOM)

23705 PROPERTIES OF A SPARK CHAMBER. E. F. Beall, B. Cork, P. G. Murphy, and W. A. Wenzel (Univ. of California, Berkeley). Nuovo cimento (10), 20: 502-8 (May 1, 1961. (In English) (UCRL-9313)

A spark chamber is constructed of seven aluminum plates, each ½ in. thick and separated by a ¼-in. gap. This device permits the trajectory of a charged particle to be observed, by detecting the light produced by a spark discharge between the plates when a high-voltage pulse is applied to alternate plates. The efficiency of this chamber is measured for high-energy charged particles. When the chamber is filled with 1 atm of neon or argon, the efficiency per gap is greater than 99%, if a ¼ μs pulse of greater than 10 kv for neon or 15 kv for argon is applied to the plates within ⅓ μs after the charged particle traverses the gap between the plates. Multiple tracks, such as those produced by a nuclear reaction in the plates can easily be photographed. The recovery time of the chamber after a spark discharge between the plates is approximately 10 ms. The sensitive time is of the order of 10 μs unless a clearing field is applied to one set of the plates. With a clearing field of approximately 160 v/cm, the sensitive time is reduced to less than ½ μs. When the chamber has $4 \cdot 10^5$ particles incident on it in 0.1 s, three tracks per trigger are sometimes observed, in agreement with the measured sensitive time. The chamber also functions with a magnetic field of 13 kgauss parallel to the plates. The tracks are displaced by an amount proportional to the magnetic field. In addition, if a high clearing field, E, is applied and if a long time is allowed to elapse before the high-voltage pulse is applied, the sparks in alternate gaps are displaced in opposite directions by an amount proportional to $E \times B$. Both the momentum and the time of traversal, relative to the time of applied voltage, can be determined in this manner. (auth)

23706 THE SPEED OF RESPONSE OF THE 56 AVP PHOTOMULTIPLIER AND ITS MEASUREMENT IN THE LABORATORY. Y. Koechlin and A. Pascal (Centre d'Etudes Nucleaires, Saclay, France). Onde elec., No. 407, 8p. (Feb. 1961). (CEA 1966). (In French)

In order to profit fully from the extremely brief duration of scintillations in time measurements in the field of nuclear physics, it is necessary to have available high-grain and high-speed photomultipliers. The Dario 56 AVP was designed with this purpose in mind and the study of its speed of response is detailed. Special methods have been developed and the corresponding control equipment has been manufactured to measure the isochronous defects in the electron paths between the various electrodes. The values calculated by the manufacturer are measured and consist of spread center to edge of the order of 0.5 ns, variation of total transit time in the tube less than 0.5 ns, and amplitude at half height of an anode pulse corresponding to a single photoelectron of the order of 2 ns. (auth)

23707 A TRANSISTORIZED RADIATION MONITOR. M. van Tol and F. Bregman. Philips Tech. Rev., 21: 201-6(1959/60). (In English)

A circuit was designed in such a manner that the monitor readings are insensitive to transistor characteristics. A method for arriving at a nonlinear scale that covers the range from zero to infinity is discussed. For the described monitor, the error is less than 10% between 0.1 and 0.9 full scale deflection. The calibration procedure is particularly straightforward. (D.E.B.)

23708 A GAS-DISCHARGE INDICATOR TUBE FOR TRANSISTORIZED DECADE COUNTING CIRCUITS.

T. P. J. Botden. Philips Tech. Rev., 21: 267-75(1959/60). (In English)

The indicator tube has a flat annular cathode with the surface divided into ten sectors and a ring shaped anode. The tube is filled with Ne + 0.1% Ar at 15 cm Hg. A gas discharge is initiated at the desired place in the tube by means of one of ten auxiliary electrodes. The control signals supplied by the transistor circuit need only make the potential of the relevant trigger differ by 5 v from that of the grounded anode. The auxiliary discharge current required to initiate the main discharge is 50 μ-amp. The tube is fed with an unsmoothed, rectified alternating voltage. (L.N.N.)

23709 PARAFFIN BASE HALOGENATED HYDROCARBON CHEMICAL DOSIMETERS. Majic S. Potsaid (Harvard Univ. Medical School, Boston and Massachusetts General Hospital, Boston) and Goro Irie. Radiology, 77: 61-5(July 1961).

An easily constructed and conveniently applied solid phantom chemical dosimeter is described which was made from chloroform, paraffin, beeswax, and methyl yellow. It gives a clear three-dimensional isodose picture of absorbed dose from all forms of ionizing radiation. (auth)

23710 APPLICATIONS OF COUNTING TUBES. F. Lafay. Rev. gén. electronique, No. 174, 14-23(May 1961).

Basic theoretical and practical considerations are given which clearly define the range of Geiger counters, ionization chambers, scintillation counters and their associated electronic equipment. (EURATOM)

23711 INVESTIGATION OF NARROW WELL IN NaI(Tl) FOR REDUCTION OF IODINE K X-RAY ESCAPE WHEN MEASURING CONTINUOUS X-RAY SPECTRA WITH COLLIMATED PHOTON BEAMS. Edward R. Epp and Herbert Weiss (Sloan-Kettering Inst. for Cancer Research, New York). Rev. Sci. Instr., 32: 651-3(June 1961).

A technique is described for the reduction of iodine K x ray escape when measuring narrow collimated beams of continuous x rays with a NaI(Tl) scintillation spectrometer. This method consists of confining the photon beam to a small well in the crystal to reduce the solid angle through which iodine K x ray escape is possible. An investigation of this technique is conducted at photon energies of 10 to 60 kev. A tail is observed on the low energy side of the photopeak, whose magnitude has an inverse dependence on photon energy. This distortion of pulse-height response is large enough to indicate that the well crystal technique is unsatisfactory when making measurements of continuous x ray spectra in the energy region where the escape of iodine K x rays is an important factor. The likely explanation is that light losses associated with the well itself are responsible for the observed tails since reflecting liners are not present. Introduction of a reflecting liner into the well is found to reduce the tail effect considerably. (auth)

23712 PULSE SHAPE DISCRIMINATION IN STILBENE SCINTILLATORS. W. Daehnick and R. Sherr (Princeton Univ., N. J.). Rev. Sci. Instr., 32: 666-70(June 1961). (PUC-1961-25)

A pulse shape discriminator is described, which is designed to permit detection of low energy neutrons in the presence of a very high γ-ray background at high counting rates. An improvement is obtained by using a fast crystal diode switch for the separation of the fast and slow parts of the scintillator de-excitation pulse. This device greatly reduces interference effects from nearly coincident detector pulses, and also permits better pulse matching and comparison. The best discrimination is obtained for moderate sensitivity and counting rates, where out of 10^5 detected γ rays about one is erroneously admitted. A description of the circuit and accessories is given, and results of test runs at a 20 Mev FM cyclotron are presented. (auth)

23713 GAMMA-RAY ATTENUATION FACTORS FOR ANGULAR CORRELATION AND ANGULAR DISTRIBUTION MEASUREMENTS. D. W. Glasgow, L. W. Coleman, and L. Schecter (Oregon State Coll., Corvallis). Rev. Sci. Instr., 32: 683-4(June 1961).

The angular resolution and azimuthal symmetry of an unshielded NaI scintillation counter are measured for gamma rays between 0.5 and 2.8 Mev, in order to estimate correction factors needed in determining angular correlation functions. The results are in agreement with corrections calculated for similar scintillation crystal geometry. (auth)

23714 DIRECTIONAL HIGH ENERGY GAMMA-RAY COUNTER. G. G. Fazio and E. M. Hafner (Univ. of Rochester, N. Y.). Rev. Sci. Instr., 32: 697-702(June 1961). (NYO-9549)

A directional Cerenkov counter is developed for detection of energetic gamma rays from balloons and satellites. It is sensitive to photons whose directions lie within a 10° cone. It is completely insensitive to backward fluxes and almost completely insensitive to charged particles. Several different versions of the system are constructed and tested in bremsstrahlung beams. The angular resolution is also indirectly confirmed by using the device to count cosmic ray μ mesons at sea level. (auth)

23715 X-RAY DIFFRACTION CAMERA FOR THE ALIGNMENT OF LARGE SINGLE CRYSTALS. R. W. Meyerhoff, D. M. Bailey, and J. F. Smith (Ames Lab., Ames, Iowa). Rev. Sci. Instr., 32: 715-17(June 1961). (IS-259)

A back-reflection Laue camera with three rotation axes and three orthogonal translation axes is described. This camera allows the alignment of large single crystals with a precision of ±0.25°. The degree of single crystallinity of a specimen may be examined. In addition it is possible to accurately mark a crystal for subsequent utilization. (auth)

23716 IONIZATION GAUGE FOR TRANSIENT GAS PRESSURES. J. D. Cobine and E. E. Burger (General Electric Co., Schenectady, N. Y.). Rev. Sci. Instr., 32: 717-20(June 1961).

The description and operating characteristics of a vacuum gauge circuit for the measurement of transient pressures in the range 10^{-4} to 10^{-7} mm Hg are presented. Rise times as short as 10 μsec are obtained with the experimental instrument. (auth)

23717 MICROWAVE SUPERHETERODYNE INDUCTION SPECTROMETER. Dale T. Teaney (Univ. of California, Berkeley), M. P. Klein, and A. M. Portis. Rev. Sci. Instr., 32: 721-9(June 1961).

The limits of electron spin resonance detection sensitivity are investigated for absorption and induction spectrometers employing superheterodyne detection. The sensitivity of the conventional bridge absorption spectrometer is found to decrease rapidly below the theoretical limit set by the noise figure of the receiver when klystron power is increased above about 10 mw. This decrease is shown to arise from the extreme frequency dependence of the bridge balance. The bimodal cavity induction spectrometer, which has a highly stable frequency independent balance, shows no departure from the theoretical limit. Flicker noise is found

to be produced by the i-f current in the mixer diodes, but it may be greatly reduced by the use of high i-f gain. The use of a balanced homodyne detector in place of the conventional second detector is found to reduce the over-all noise figure of the receiver from 13 to 9 db by suppression of carrier noise. The performance of the bridge spectrometer is greatly improved by the homodyne detector, which discriminates against frequency noise that enters when the bridge drifts away from balance. (auth)

23718 PRECISE DETERMINATION OF EFFECTIVE PAIRED-PULSE RESOLUTION OF A NUCLEAR COUNTING SYSTEM. Laurence S. Beller (Atomics International, Canoga Park, Calif.). Rev. Sci. Instr., 32: 751-2(June 1961).

A method is described for determining the resolving time of a nuclear counting system, under the condition that the basic counting rate is high enough to make the counting uncertainties negligible. A variation, the time dependence of which is known, is introduced into the basic count rate. A χ^2 test is performed on the data obtained using the known additional activity; the χ^2 function has a minimum at the effective resolving time of the counting system. (T.F.H.)

23719 ACTIVATOR DISTRIBUTION IN NaI(Tl). A. S. Kheinman (All-Union Cinematography Research Inst., Moscow). Soviet Phys.-Crystallography, 5: 915-16(May-June 1961).

A review of previous work using Vegard's law as a test for the KCl–TlCl and NaI–TlI systems is given. Lattice parameters were calculated for both systems. (P.C.H.)

23720 TRACK OF FAST ELECTRONS. PICTURES OF ELECTRON AND X RADIATION OF A 35-Mev BETATRON WITH A PROPANE-FILLED BUBBLE CHAMBER. Dietrich Harder, Gert Harigel, and Klaus Schultze (Max-Planck-Institut für Physik und Astrophysik, Munich and Universität, Würzburg, Ger.). Strahlentherapie, 115: 1-21(May 1961). (In German)

In illustrating the tracks of electrons and positrons which traverse the tissue during irradiation with fast electrons and ultrahard x rays, track pictures taken with a propane-filled bubble chamber are demonstrated. The elementary interaction processes as well as the individual destinies of particles on their tracks and the properties of ray-bundles can be made visible. Energy absorption and scattering, increase of linear energy transfer at the ends of electron tracks, and the reasons for the shapes of depth dose curves in x-ray and fast electron therapy are discussed. (auth)

23721 PRIMENENIE DIFRAKTSIONNOGO SPEKTRAOGRAFA DFS-3(13) DLYA ANALIZA MINERAL'NOGO SUR'YA. (Applications of Diffractions Spectrograph DFS-3 (13) for Analysis of Mineral Resources). S. K. Kalinin, E. E. Fain, and V. M. Perevertun. Alma-Ata, Kazakh SSR, Publishing House of the Academy of Sciences, 1960. 36p.

Characteristics, performance, and optical properties of a diffraction spectrograph are described. The techniques for determining small quantities of Bi, Ge, W, Re, Tl, Zn, and others in ore are discussed. (R.V.J.)

23722 IMPROVEMENTS IN OR RELATING TO A. C. POLAROGRAPHS. Geoffrey Cecil Barker (to United Kingdom Atomic Energy Authority). British Patent 870,451. June 14, 1961.

Circuit diagrams and modulation curves are used to describe an a-c polarograph. There are means for modulating the amplitude or the frequency of the a-c component of the current flowing in the polarograph cell and the modulating waveform may be sinusoidal or square-wave. The polarograph also contains detector means for measuring currents resulting from the demodulation of the a-c component by electrode reactions as a result of the non-linear variation of their rates with potential. The detector means is phase-sensitive or time-sensitive. (N.W.R.)

23723 RADIOACTIVITY MONITOR. (to Atomic Energy of Canada Ltd.). British Patent 871,944. July 5, 1961.

A radioactivity monitor for monitoring the effluent from coolant tubes of a nuclear reactor is described. There is a first detector adapted to detect radioactivity from all the tubes. Then there is a valve means adapted to cause the effluent from each coolant tube to flow through a sample pot individual to the coolant tube. When the radioactivity rises to a predetermined level in the first detector, a second detector scans and indicates the radioactivity of each sample pot therefore giving the effluent from each coolant tube. The second detector is shielded and rotates automatically when the predetermined level is reached. The sample pots are arranged in a circle around the second detector. A layout of the monitoring system is shown. (N.W.R.)

23724 METHOD OF MANUFACTURE OF CAPACITORS. (to Standard Telephones and Cables, Ltd.). British Patent 872,539. July 12, 1961.

A manufacturing method is described for capacitors which includes the step of passing a layer of dielectric material upon a metal strip longitudinally through a beam of ionizing radiations in such a way as to produce cross-linking between the molecules of the dielectric. After irradiation the layer of dielectric is passed over a crucible and a layer of metal is deposited upon its surface. (N.W.R.)

23725 IMPROVEMENTS IN OR RELATING TO INSTRUMENTS. John William Hill, William Laws, and Alec Thomson (to United Kingdom Atomic Energy Authority). British Patent 872,813. July 12, 1961.

An instrument capable of presenting information from which the quality of the internal state of a fluidized bed enclosed within a chemical reactor vessel can be deduced is described. The instrument consists of an electrically heated probe, means for maintaining the probe at a constant temperature higher than that of the fluidized bed, and means for measuring the power fed to the probe. The probe consists of a bead having a high electrical resistivity coupled with a high negative temperature coefficient of resistance and small thermal capacity. The bead is sealed in a tube of insulating material so as to leave part of the bead surface exposed. There are electrical connections from the bead passing through the tube of insulating material. The insulating tube is mounted in a protective tube with the bead surface exposed. The electronic circuit is diagrammatically shown. (N.W.R.)

23726 IMPROVEMENTS IN OR RELATING TO PORTABLE DOSIMETERS. Donald Fenn Burnett (to Rank Precision Industries, Ltd.). British Patent 873,071. July 19, 1961.

A description is given of a portable dosimeter incorporating a fiber electrometer co-operating with a deflection electrode within an ionization chamber. The ionization chamber and the deflection electrode are constructed of a material of a lower atomic number than air and the fiber is mounted on support means of higher atomic number than air. The portion of the support means actually exposed to the air of the ionization chamber is restricted and arranged to enable its adverse effect to be compensated by the material of lower atomic number. The ionization rate

per unit volume of the air within the ionization chamber is approximately equal to that of free air exposed to radiation of the same quality and intensity. (N.W.R.)

23727 MANIPULATING DEVICES HAVING MASTER AND SLAVE PORTIONS FOR THE REMOTE HANDLING OF OBJECTS. Patrick Hay Stephenson (to Pye, Ltd.). British Patent 873,077. July 19, 1961.

A manipulating device for the remote handling of objects is described. The device consists of a horizontal tubular support to opposite ends of which are pivotally attached a master arm and a slave arm. There is a linkage mechanism interconnecting the arm in order that movement can be imparted to the slave arm by movement of the master arm. There is also a manipulating tool at the end of the slave arm operable by controls on the master arm. A mechanism is provided for effecting lateral displacement of the slave arm out of the plane containing the tubular support and the master arm. Instead of pivoting the master arm of the manipulator to a member which is rigidly attached to the tubular support or through-tube as in prior constructions, the master arm is pivotally attached to a housing which can rotate relative to the through-tube. An electric actuator provides the relative rotation between the master arm and the through-tube. (N.W.R.)

23728 SEMI-CONDUCTOR APPARATUS FOR THE DETECTION OF NEUTRONS. H. Welker and R. Gremmelmaier (to Siemens). German Patent DAS 1 025 533. Mar. 6, 1958.

The semi-conductor consists mainly of In^{115} phosphide or nitride. Under neutron bombardment, one of its components becomes β- or γ-active and some of its electrical properties, in particular its conductivity, are altered; the measurement of these changes shows whether neutrons are present, even when the neutron flux is extremely small. (EURATOM)

23729 DEVICE TO MEASURE AND REGULATE THE TEMPERATURE OF NUCLEAR REACTORS. W. Heimann. German Patent DAS 1 093 501. Mar. 28, 1959.

The device gives indications not only on the temperature of the coolant as is the case in many reactors, but also on the temperature of all the hot parts of the reactor moderator, reflector, and fuel elements. The heat radiated by these parts is detected by an electronic tube (sensitive to heat) and indications are then transmitted to a control room by television. (EURATOM)

Materials Testing

23730 (DASA-1198) BLAST LOAD TESTS ON POST-TENSIONED CONCRETE BEAMS. Technical Report No. 116. H. T. Miyamoto and J. R. Allgood (Naval Civil Engineering Lab., Port Hueneme, Calif.). May 29, 1961. 87p.

Four types of post-tensioned prestressed concrete beams with straight unbonded bars were tested under static and blast loading to study their behavior. The tests showed that the response of prestressed beams can be predicted by a one-degree of freedom system provided the correct damping and resistance functions are known. (auth)

23731 (NRL-5609) PROCEDURES FOR THE EVALUATION OF FRACTURE TOUGHNESS OF PRESSURE-VESSEL MATERIALS. W. S. Pellini and J. E. Srawley (Naval Research Lab., Washington, D. C.). Feb. 23, 1961. 26p.

Normal design procedures for internally and externally pressurized vessels are based on the criteria of failure by general yielding or instability. Such procedures are valid if the fracture toughness of the material, as fabricated, is sufficient to prevent failure by a fracture mode. The degree of fracture toughness required is known to vary with the design, service conditions, and method of fabrication. Because of the complexity of the interactions of these factors, the specific fracture-toughness requirement is ordinarily determined by the testing of models and of full-scale vessels, with correlation to laboratory fracture tests. The requirement for submarine hull structures, as determined by explosion tests of weldments, is defined as an extremely tough condition associated with the restricted propagation of shear tearing fractures. Charpy V tests provided effective laboratory-specimen correlations for steels of low and intermediate strength levels. For materials of higher yield-strength-to-density ratios, it appears that the level of toughness associated with full shearing decreases; this may prove to be a limiting factor. Thin high-strength materials for airframes and rockets are evaluated quite differently, most commonly by direct determination of the effect of cracks on fracture stress—a tiny crack in a very-high-strength material can induce fracture at a fraction of the yield strength. Stress-analysis methods are employed to derive values of a characteristic fracture-toughness property through which, ideally, fracture stress may be related to flaw size. Temperature transitions do occur but, again, full-shear toughness diminishes with increasing strength level. If a very small, maximum flaw size can be guaranteed, it is possible to use a material of very high yield strength below its full-shear temperature. (auth)

23732 HIGH TEMPERATURE X-RAY DIFFRACTION TECHNIQUES FOR ACTIVE METALS. J. J. Hanak and A. H. Daane (Ames Lab., Ames, Iowa). Rev. Sci. Instr., 32: 712-14(June 1961). (IS-200)

Techniques are described for obtaining x ray diffraction information on active metals at high temperatures. One method is used to 1000°C with rare earths; the other method is used to 2200°C with tungsten, and to 1400°C with some of the higher melting rare earths. The latter approach permits simultaneous measurement of resistance of the specimens vs temperature and the diffraction pattern, which facilitates the characterizing of the high temperature forms of the metals. (auth)

23733 IMPROVEMENTS IN OR RELATING TO CHUCKS, PARTICULARLY FOR USE IN INSPECTING FUEL ELEMENTS OF NUCLEAR REACTORS. (to Commissariat a l'Energie Atomique). British Patent 870,708. June 14, 1961.

A chuck designed for use in inspecting reactor fuel elements and adapted to grasp the element in a predetermined longitudinal position with respect to the chuck is described. The chuck automatically rotates and stops at predetermined angular positions. The chuck contains a fixed plate on which a movable plate is mounted for rotation. There are movable jaws mounted in the movable plate that are normally resiliently urged toward the center of the chuck. Operating members are provided for moving the jaws outward. The members are comprised of rotary cams movable independently of the movable plate, each cam is positioned to operate one of the jaws through an intermediate lever pivotally mounted on the fixed plate. Means are provided for rotating the movable plate. Rotation is controlled by electric switches actuated by the movable plate at predetermined angular positions. The jaws are provided on their gripping surfaces with friction linings. Electric motors rotate and control the cams and the movable plates. (N.W.R.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

23734 (LAMS-2526(p.202-13)) RADIOACTIVITY OF TEKTITES. M. W. Rowe, M. A. Van Dilla, and E. C. Anderson (Los Alamos Scientific Lab., N. Mex.).

Three groups of tektites from various parts of the world were measured for γ radioactivity. The γ spectrum of the samples is plotted along with the spectra of a stone meteorite and terrestrial rock sample. Results indicate that tektites are similar to terrestrial rocks in U, Th, and K concentrations and that the stone meteorites have much lower concentrations. This evidence is interpreted as supporting the theory of terrestrial origin of tektites. (C.H.)

23735 (NP-10210) APPLICATION OF WEATHER RADAR TO FALLOUT PREDICTION. Quarterly Technical Report No. 10, Covering Period June 1, 1960 Through August 31, 1960. Pauline M. Austin (Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy). Sept. 15, 1960. Contract DA 36-039- SC-75030. 20p.

Excellent radar data in the form of signal intensity contours and RHI photographs were obtained for 29 summer storms including several squall lines. In addition, a few measurements of the reflectivity at two wavelengths of clear-air echoes from the vicinity of a sea-breeze front, some concurrent echo-intensity and fluctuation-rate records, and several simultaneous radar and rain gauge observations were made. All of the intensity-contour data from the summer of 1959 and some selected storms from 1960 were transcribed from 35 mm film to contour maps on transparent paper. Also the data from six instability lines observed in 1958 were digitalized. Some of the rain-out computations were completed. The results are summarized. They show the effect on the distribution of radioactive fall-out at the ground, 12 hours after a one-megaton detonation, of standard showers inserted at selected points 3, 6, and 9 hours after the detonation and also the modification produced by a widespread rain area. Further investigations of rain-out in the case of a megaton detonation are being planned and, in addition, machine programs are being set up to compute the effects of rain-out in the case of 10 kT and 0.1 kT detonations. (auth)

23736 (TEI-778) GAMMA-RADIOACTIVITY INVESTIGATIONS AT THE NEVADA TEST SITE NYE AND LINCOLN COUNTIES, NEVADA. Carl M. Bunker (Geological Survey, Washington, D. C.). Feb. 1961. 146p.

Measurements of gamma radioactivity in tunnels and drill holes at the Nevada Test Site were made to determine quantitatively the natural radioactivity of geologic formations and to determine the distribution of explosion-produced radioactivity in the vicinity of nuclear explosions. Tunnel walls were surveyed with portable scintillation detection equipment and drill holes were logged with Geiger-Mueller and scintillation detectors. These measurements were started in 1957 and completed in February 1960. Natural radioactivity was measured in alluvium and in 8 units of the Oak Spring formation (tuff), marble, dolomite, and granite. The highest radioactivity was observed in granite; the lowest radioactivity was in marble and dolomite. Radioactivity in alluvium is related to the amount of cementation; the radioactivity is highest where cementation is lowest. Drill-hole logs generally show contacts between rock types of changes in radioactivity at the contacts, location of the water level in the drill holes, and location of casing. Radioactivity surveys in the tunnel systems seldom show contacts between the types of tuff penetrated by the tunnels. Drill holes in a waste disposal area were gamma-ray logged before and after a part of the area was flooded with a water-borne radioactive tracer. The logs showed that most of the tracer accumulated at the lower end of the area and that movement was confined to a distance less than 4 ft from the tile through which the tracer flowed. Measurements in the vicinities of the Rainier and Neptune nuclear explosions show that explosion-produced radioisotopes are distributed in nearly hemispherical configurations. Radioisotopes produced by the Rainier explosion are concentrated in two nearly concentric hemispheres below the explosion point and are associated with radioactive glass. (auth)

23737 (TID-13126) STUDIES RELATING TO THE DEVELOPMENT OF PROCEDURES FOR THE GEOLOGIC DATING OF CORALS AND OTHER CALCAREOUS MARINE AND TERRESTRIAL MATERIALS. Progress Report. (Washington Univ., St. Louis). June 28, 1961. Contract AT(11-1)-581. 9p.

The Th^{230}/U^{238} method of dating was applied to coral core samples from Muzinkarikku Island, to shells from Californian marine terraces, and to Greenland shells. The results are compared with those from the C^{14} dating method. The conditions required for the Th^{230}/U^{238} method to be valid are discussed. (D.L.C.)

23738 (USASRDL-TR-2140) THEORY OF SIGNAL CORPS METHOD FOR PREDICTION OF RADIOACTIVE FALLOUT PATTERNS. B. F. Watson, Donald M. Swingle, and W. J. Richards (Army Signal Research and Development Lab., Fort Monmouth, N. J.). Oct. 1960. 31p. (AD-252456)

A basic nuclear cloud model is established, and from this a theory for the distribution of radioactive fall-out is developed. A more rigorous treatment of the subject than was previously given is presented; but it does not provide the tables, graphs, and description needed to actually make a fall-out prediction. (P.C.H.)

23739 (AEC-tr-4487) MINERALS OF URANIUM: REFERENCE BOOK. (Mineraly Urana: Spravochnik). M. V. Soboleva and I. A. Pudovkina. A Translation from a publication of the State Scientific Technical Publishing House for Literature on Geology and the Preservation of Mineral Resources, Moscow, 1957. 464p.

The methods of analyzing uranium minerals and a detailed study of their properties are presented. The shape of the minerals, their physical and optical properties, their chemical composition, and descriptions of their specific natural location are included. Radiometric, luminescent, radiographic, impression, chemical, and optical methods of analysis are discussed. The optical constants and specific weights of the minerals are presented in tabular form. (M.C.G.)

23740 (JPRS-7455) REPORT ON SCIENTIFIC WORK IN METEOROLOGY AND PHYSICS OF THE ATMOSPHERE 1957–1959. Translated from p.1-204 of "Soobshcheniye o Nauchnykh Rabotakh po Meteorologii i Fizike Atmosfery, 1957–1959." 182p.

Reviews are presented on results of Russian studies in the period of 1956 to 1958 in the fields of dynamic and synoptic meteorology, climatology, actinometry and atmospheric optics, physics of clouds and precipitation, physics of the atmosphere and turbulence, meteorological and aerological instruments, and atmospheric electricity. The

brief reviews are followed by detailed bibliographies. (D.L.C.)

23741 FALLOUT MEASUREMENTS IN RIO DE JANEIRO 1956-1960. E. Meyer, A. Aron, and I. Emygdio de Castro (Instituto Nacional de Technologia, Rio de Janeiro). Anais acad. brasil. cienc., 33; No. 1, 35-40(Mar. 1961). (In English)

The filtering method in which atmospheric air is driven through a special filter by means of a small blower, has been used to measure fall-out activity in Rio de Janeiro, Brazil. The results for each year are plotted in $\mu\mu c/m^3$ of air. (L.N.N.)

23742 BOND ENERGY AND CONSERVATION OF RADIOGENIC ARGON IN MICA. S. S. Sardarov (Makharkala Inst. of Geology, Degestan Branch of the Academy of Sciences, USSR). Geokhimiya, No. 1, 30-8(1961). (In Russian)

The bond energy of Ar^{40} with surrounding muscovite lattice elements is equal to 8.3 kcal/g/atom. The energy is to weak to hold the Ar^{40} atoms in the lattice, but the surrounding ion bond is able to hold them in. The constant ratio of Ar^{40}/K^{40} in the central and peripheral regions of mica indicate the lack of Ar^{40} diffusion. The relation between the radiogenic argon nascent state and the initial endothermal separation of muscovite structural water was found. (R.V.J.)

23743 ON THE PRESERVATION STATE OF RADIOGENIC ARGON IN GROUND POTASSIUM-CONTAINING MINERALS. E. K. Gerling, I. M. Morozova, and V. V. Kurbatov (Lab. of the Precambrian Geology and Khlopin Radium Inst., Academy of Sciences, Leningrad). Geokhimiya, No. 1, 39-48(1961). (In Russian)

The effect of mica and microcline grinding on the preservation state of radiogenic argon in them was studied. Micas were ground in a mechanical mortar, filed, and cut with scisors. The microcline was crushed to fractions of 3 to 1 mm and ground in a mechanical mortar. For all the selected fractions the values of activation energy (E) of the radiogenic argon isolation were determined, and debyegrams were taken. For the cut muscovite E = 93000 cal/g = argon atom and 64% of argon is bound with it. For two small mica fractions in the temperature interval 500 to 800°C three values of activation energy were obtained, equalling 18000, 37000, and 72000 cal/g = Ar atom. For the sample of ground mica argon losses reached 30%. During the microcline grinding the amount of easily isolating argon increased from 20 to 70%, which is connected with the change of the activation energy values. The revealed structural changes, due to grinding, are confirmed by the roentgenograms which were taken. (auth)

23744 CONTRIBUTION TO THE INTERPRETATION OF AGE FIGURES ACCORDING TO THE LEAD METHOD. K. K. Zhirov, G. I. Shestakov, I. B. Ivanov (Inst. of Geochemistry, Siberian Dept., Academy of Sciences, USSR). Geokhimiya, No. 1, 49-55(1961). (In Russian)

A nomogram was plotted showing the dependence of age according to the ratios 207/206, 207/208, 206/238, and 208/232 on the removal of various lead, uranium, and thorium amounts at different times for minerals changing age of 1900×10^6 years. Ratios of the age are shown for different pairs of isotopic ratios according to the intensity and the time for lead, uranium, and thorium removal. The peculiarities in the age change are shown on the example of a simultaneous removal of equal amounts of lead, uranium, and thorium. (auth)

23745 THE ABSOLUTE AGE OF RARE-METAL PEGMATITES OF THE EASTERN SAYAN. Yu. S. Sifpnev and L. L. Shanin (Inst. of Mineralogy, Geochemistry and Crystal Chemistry of Rare Elements, Academy of Sciences, Moscow). Geokhimiya, No. 1, 56-9(1961). (In Russian)

A brief summary of the geological characteristics of rare-metal pegmatites of the Eastern Sayan is given. According to muscovite their age was determined by the potassium-argon method to be 1700 to 1800 million years; according to microcline, 1300 million years. On connection with the incomplete preservation state of radiogenous argon in the microcline, the age of the rare-metal pegmatites of the Eastern Sayan is adopted as 1700 to 1800 million years (data according to muscovite). (auth)

23746 THE CONTAMINATION OF RIVERS WITH FISSION PRODUCTS FROM FALLOUT. A. Morgan and D. G. Stanbury (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Health Phys., 5: 101-7(June 1961).

The concentrations of some fission products in rain water falling on the catchment areas of three Thames tributaries are compared with the concentrations in river water over monthly periods. The fission products selected were Sr^{89}, Sr^{90}, Cs^{137}, and Ce^{144}. A comparison of the concentrations in corresponding samples of rain and river water showed that natural decontamination factors were smallest for Sr^{90} and greatest for Ce^{144}. The Sr^{90} concentrations in river water appear to depend to some extent on the permeability of the subsoil in the catchment area, which suggests that surface run-off is an important source of contamination. The amount of Sr^{90} leaving each catchment area in the river is compared with the amount deposited. Normally less than 1% leaves, but in periods of heavy rain and high flow rates this may be considerably increased due to desorption from the soil and enhanced run-off. The effect on the Sr^{90} concentration in river water of increased testing of nuclear weapons and a reactor accident are discussed briefly. (auth)

23747 ORIGIN OF RADIOACTIVE FALLOUT IN THE NORTHERN HEMISPHERE AFTER THE SPRING MAXIMUM IN 1959. J. F. Bleichrodt, Joh. Blok, and E. R. van Abkoude (National Defence Research Organization TNO, Rijswijk, Z. H., Netherlands). J. Geophys. Research, 66: 2183-7(July 1961).

Evidence is presented that an insignificant fraction of debris from the Soviet nuclear test explosions in October 1958 was present in the lower stratosphere at the end of 1959 and that fall-out during 1960 mainly orginated from injections into the tropical stratosphere during 1958. (auth)

23748 PASSAGE OF A NUCLEAR FISSION PRODUCT DUSTS UPWARD WITHOUT CONTACT WITH THE GROUND. Animesh Chakravorty (University Coll. of Science, Calcutta). Naturwissenschaften, 48: 375(May 1961). (In German)

The radioactive fission products measured at a valley and a mountain station in the northern Alps showed a discrepancy in the activity at the two stations. At a mountain station an activity higher than the mean level and higher than the maximum value of the previous 9 months was found. At the valley station no increase was detected. These observations led to the conclusion that atmospheric monitoring at flatland or valley stations is incomplete. The activity peaks were obtained 17 days after the third nuclear explosion in the Sahara. (J.S.R.)

23749 THE USE OF RADIOACTIVE ISOTOPES FOR THE STUDY OF LITTORAL DRIFT. J. J. Arlman (N. V. Philips-Duphar Isotope Lab., Amsterdam), J. N. Svašek,

and B. Verkerk. Philips Tech. Rev., 21: 157-66(1959-60). (In English)

In coastal and fluvial engineering works it is sometimes necessary to know in what way and in what quantities sand and mud at a given location will be transported by currents and waves. This problem is of great significance in the Netherlands Delta Project. The comprehensive program of measurements set up by the Dutch Rijkswaterstatt to follow the gradually changing hydrographic situation around the coast includes direct measurements of sand movements by means of radioactive tracers. Compared with other tracer applications this involves the use of large amounts of radioactive materials; careful preliminary investigations were therefore required to decide on questions of procedure and radiation protection. (auth)

23750 RADIOACTIVITY IN TEXAS STREAMS. W. R. Drynan (Univ. of Texas, Austin), E. F. Gloyna, and D. F. Smallhorst. Univ. Illinois Circ. 58: No. 83, Eng. Expt. Sta., Circ. No. 69, 28-33(July 1961).

Early results from a 3-year program to collect base-line data on radioactivity in Texas waters are reported. When preliminary tests indicate the presence of significant quantities of either alpha or beta emitters, a gamma spectrum and a radiochemical separation of Sr and Ra is made. The instruments most frequently used in counting river samples are of the proportional gas flow type. Most of the samples collected throughout the state had less than 50 $\mu\mu c/l$ of beta activity and 10 $\mu\mu c/l$ of alpha activity. Tables are given of the gross radioactivity analyses of samples from the Canadian and Neches Rivers in Texas along with the dates the samples were collected. (P.C.H.)

23751 GAMMA-SPECTROMETRIC MEASUREMENTS OF ATLANTIC OCEAN WATER RADIOACTIVITY. B. A. Nelepo. Vestnik Moskov. Univ. Ser. III. Fiz., Astron., No. 5: 36-42(Sept.-Oct. 1960). (In Russian)

The design and performance of apparatus constructed for measuring the γ spectra of sea water are described, and data are given from measurements made in 1959 between 22° 45′ S latitude 63° 06′ W longitude and 15° 22′ N latitude 20° 56′ W longitude. The uniform distribution of radioactivity indicates an atmospheric origin of contamination. Three well defined layers were observed between the surface and a depth of 120 m. The highest specific activity was in the upper 40-m layer; the intermediate layer exhibited a sharp drop in activity and had a passive layer under it with a negligible specific activity. The drop in specific activity is related to the half lives of identified elements (from 2 to 33 years). (R.V.J.)

23752 SOME RESULTS OF MEASUREMENTS OF WATER RADIOACTIVITY IN ANTARCTIC REGION OF PACIFIC OCEAN. B. A. Nelepo. Vestnik Moskov. Univ. Ser. III. Fiz., Astron., No. 5: 43-6(Sept.-Oct. 1960). (In Russian)

The radioactivity of Pacific Ocean waters was measured in 1958 at 67° 37′ S latitude and 165° 44′ E longitude to 27° 0.8′ S latitude and 109° 26′ W longitude. The results of four sets of measurements at 10 m depth showed radioactivity levels of $7.8 \pm 0.2 \times 10^{-10}$, $7.7 \pm 0.2 \times 10^{-10}$, $7.6 \pm 0.1 \times 10^{-10}$, and $7.7 \pm 0.2 \times 10^{-10}$. The highest level of fission products was found in the upper mixed layer at about 50 m depth. Radioactivity diminishes with the depth from 50 to 150 m. (R.V.J.)

HEALTH AND SAFETY

23753 (AD-254046) DEVELOPMENT OF A DEVICE TO PROVIDE PROTECTION FOR THE EYES AGAINST THE DAZZLE EFFECT OF A NUCLEAR WEAPON. Final Report. Walter Timm (Mine Safety Appliances Co., Pittsburgh). July 18, 1960. Contract DA-19-129-QM-1448 (O. I. 9178). 33p.

A feasibility study of materials and methods for producing a louvered-effect laminate for glare protection from a nuclear weapon was made. The materials, method, and fabrication of the louvered-effect acrylic lens is discussed. Results show that it is possible to produce a lens for both ballistic and glare protection that meet the requirements set by the Quartermaster Research and Engineering Command. (P.C.H.)

23754 (HASL-113) HEALTH AND SAFETY LABORATORY FALLOUT PROGRAM. QUARTERLY SUMMARY REPORT, MARCH 1, 1961. THROUGH JUNE 1, 1961. Edward P. Hardy, Jr., Joseph Rivera, and Robert Frankel (New York Operations Office. Health and Safety Lab., AEC). July 1, 1961. 121p.

Data are presented from the HASL fall-out Program and the U. S. Naval Research Laboratory that have become available during the period March 1, 1961 to June 1, 1961. Radionuclide levels in deposited fall-out, and in air, water, milk, bread, and other foods are given in tabular form. Interpretive reports dealing with atmospheric and fall-out radioactivity measurements, Sr^{90} and Ra^{226} in U. S. diets, and analytical errors in the strontium program, are included. A bibliography of recent literature is included. (auth)

23755 (HMI-B-18) RADIOAKTIVITÄT IN DER UMGEBUNG DES BER IM JAHRE 1960. (Radioactivity in the Surrounding of the BER in 1960). W. Jacobi (Hahn-Meitner-Institut für Kernforschung, Berlin). June 1961. 18p. (BC-16)

The results of measurements of Rn decay products and total fission products in air, fallout, and surface water in the surroundings of the BER during 1960 are summarized and compared with data from earlier years. The mean specific fission product activity has decreased to about 10% of the values during 1959. Similar to earlier years, the seasonal variation of artificial radioactivity, owing to the transport mechanism from stratosphere to troposphere, can be recognized. Operation of reactor and laboratories brought no detectable increase of activity and dose in the surroundings. (auth)

23756 (HW-SA-2170) RADIOLOGICAL PROTECTIVE APPAREL PROGRAM AT HANFORD. T. C. Mehas (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [nd]. 11p.

Presented at the Health Physics Society Meeting, Las Vegas, Nevada, June 13-16, 1961.

A program is described for providing adequate radiological protective clothing for all employees. The program consolidates all protective clothing requirements and the development and evaluation of clothing to be utilized, and establishes sound criteria for future procurement of accepted clothing. A council composed of representatives from all interested groups provides an effective means of consultation for the development, evaluation, and establishment of acceptable radiological apparel. Specifications and standards were established for use in the procurement of radiological protective apparel. Items of a non-launderable nature are warehoused and dispersed as requested. Routine reuse items which are laundry-maintained are dispersed through a central laundry facility. A chart illustrates the organization of the program. (C.H.)

23757 (KY-371) ENVIRONMENTAL MONITORING SUMMARY FOR THE PADUCAH PLANT FOR 1960. E. G. Brown and R. C. Baker (Union Carbide Nuclear Co. Paducah Plant, Ky.). May 31, 1961. Contract W-7405-eng-26. 17p.

Outdoor monitoring of air, water, and vegetation in the vicinity of the Paducah Plant is summarized for the year 1960. The mean analysis of all air samples collected along the plant perimeter was 0.21×10^{-12} μc of uranium per cm^3 of air sampled. The mean fluorided content of air samples collected along the perimeter fence was 4.5 ppb. The difference in the mean upstream and downstream beta activities was found not to be significant at the 5% probability level. (M.C.G.)

23758 (LAMS-2526(p.106-20)) CESIUM^{137} LEVELS IN PEOPLE. E. C. Anderson and B. E. Clinton (Los Alamos Scientific Lab., N. Mex.).

Data on Cs^{137} levels in people, compiled from measurements using the Humco I whole-body liquid scintillation counter, are tabulated by regions of the U. S. for a 5-yr period. Absolute values of the Cs^{137}/K level in pc/g are 20 to 30% higher than measurements made at Harwell. (C.H.)

23759 (LAMS-2526(p.129-32)) SURVEY OF LOCAL CONDITIONS AT EACH MAJOR STATION IN THE LAST MILK SAMPLING NETWORK. G. M. Ward (Los Alamos Scientific Lab., N. Mex.).

Weekly samples of dried skim milk or dried buttermilk from a network of plants in the U. S. and Canada have been analyzed for Cs^{137} and K^{40} since 1957. This network reached a maximum of 55 sampling points in 1959 and was reduced to 16 on July 1, 1960. The mass of information provides a rather complete picture of fall-out during the past 5 years. Results are presented from a survey on local conditions which might affect fall-out measurements at the 16 remaining stations. (C.H.)

23760 (LAMS-2526(p.251-60)) LETHALITY STUDIES WITH FISSION NEUTRONS: BURST VERSUS STEADY STATE EXPOSURES. J. F. Spalding, J. A. Sayeg, and T. T. Trujillo (Los Alamos Scientific Lab., N. Mex.).

The LD_{50}^{30} for fission neutrons delivered at an average dose rate of approximately 2×10^6 rads/min was 193 rads. In steady state exposure, dose rate varied from 10 to 14 rads/min with varying source-to-specimen distance. Under these conditions, the LD_{50}^{30} was 202 rads. Six steady state exposures with a constant dose rate of 12 rads/min gave an LD_{50}^{30} of 206 rads. All 3 LD_{50}^{30} observations, regardless of dose rate or method of exposure, were the same within the 95% confidence limits. The exposure data were pooled and the resultant LD_{50}^{30} was 204 rads with a standard error of 2.7 rads and 95% confidence limits between 209 and 198 rads. The LD_{50}^{30} for gamma rays with female mice of the same strain and age was 782 rads, the standard error was 8.0 rads, and the 95% confidence limits were from 767 to 799 rads. From these data, the RBE of fission neutrons with respect to Co^{60} gamma rays for production of lethality in mice was found to be 3.84 ± 0.06. (auth)

23761 (LAMS-2526(p.314-24)) SILVER PHOSPHATE AND COBALT GLASS SYSTEMS FOR GAMMA DOSIMETRY

IN MIXED RADIATION FIELDS. E. R. Ballinger, D. G. Ott, and J. W. Enders (Los Alamos Scientific Lab., N. Mex.).

Problems encountered in gamma dosimetry in a mixed radiation field of unknown energy and spectra are discussed. The design, development, and testing are described of a γ dosimetry system covering the range from 10 to 10^7 rads in γ-neutron fields. The components of the dosimetry system include $AgPO_3$ glass rods, Co glass plates, a Li^6Pb dosimeter container, a microphotofluorometer, and a chemical dosimeter reader. Curves showing the response of the $AgPO_3$ and Co glass dosimeters are included. (C.H.)

23762 (LAMS-2526(p.335-8)) GAMMA AND NEUTRON DOSE MEASUREMENTS OF B-57 SAMPLER AIRCREWS DURING KIWI-A THREE OPERATION. E. R. Ballinger (Los Alamos Scientific Lab., N. Mex.).

Measurements were made of γ and neutron doses received by the crew of a B-57 aircraft during sampling missions for Kiwi-A operation. The γ and neutron dosimetry methods are described. Five of 6 crew members also had measurements of whole-body radioactivity both before and after the mission. Dosimeter readings are compared with actual body counts of crew members. (C.H.)

23763 (LAMS-2526(p.339-42)) THE USE OF GRAPHITE–CO_2 IONIZATION CHAMBERS FOR THE DETERMINATION OF GAMMA FLUX AND THE EFFECTIVE TRANSMISSION OF THE FRONT PENTHOUSE FACE OF TEST CELL "C" DURING KIWI-A PRIME AND KIWI-A THREE. F. C. V. Worman (Los Alamos Scientific Lab., N. Mex.).

Design changes are described for graphite–CO_2 ionization chambers used for measuring γ flux in the presence of neutrons and to determine the transmission of a 4.75 ft concrete wall for γ radiation during operation of the Kiwi reactors. Results of measurements made both inside and outside of the test cell are reported. (C.H.)

23764 (LAMS-2526(p.343-5)) INTEGRAL NEUTRON AND GAMMA DOSE MEASUREMENTS ON KIWI-A PRIME AND KIWI-A THREE. P. S. Harris, F. C. V. Worman, E. F. Montoya, and D. G. Ott (Los Alamos Scientific Lab., N. Mex.).

Measurements were made to determine the radiation output of the Kiwi-A Prime and Kiwi-A Three reactors during operation. Integral γ doses at selected positions were determined using glass rod dosimeters contained in specially made Li^6 cans which eliminated the thermal neutron portion of the total response. By the judicious use of Co glass plates, as well as the rods, the dose range was extended into the millions of rads region. Neutron fluxes and doses were determined using the fission foil system. Gold foils and S pellets in B^{10} containers were used to extend the measurements into the thermal and high energy regions. The integral neutron and γ measuring systems functioned satisfactorily. Results are not given in detail. (C.H.)

23765 (NAVWEPS-7346) BERYLLIUM, ACTUAL AND POTENTIAL RESOURCES, TOXICITY, AND PROPERTIES IN RELATION TO ITS USE IN PROPELLANTS AND EXPLOSIVES. Russell McGill (Naval Ordnance Lab., White Oak, Md.). Nov. 14, 1960. 39p. (AD-253297)

The actual and potential supply of beryllium, and the toxicology of beryllium and its compounds are discussed. Health and safety factors are also discussed. (P.C.H.)

23766 (NDA-2147-5) FAST REACTOR SAFETY. Quarterly Progress Report for the Period Ending December 31, 1960. J. Agresta and F. Beers (Nuclear Development Corp. of America, White Plains, N. Y.). Mar. 15, 1961. Contract AT(30-1)-2303. 21p.

Investigations were made of fast reactor safety. Sodium two-phase flow regimes were charted to show the different flow pattern regions as a function of quality and total mass velocity. The pressure losses resulting from frictional resistance for two-phase sodium flow were obtained. Vapor-volume fraction and slip and pressure drops resulting from momentum changes were investigated. A systematic study of the effects on reactor stability of both negative and positive power coefficients which may be prompt or delayed was begun. The effect on stability of delayed negative power coefficients of both the conduction and convection types was determined. (M.C.G.)

23767 (NYO-9529) STUDIES OF NUCLEAR DEBRIS IN PRECIPITATION. Progress Report No. 6. Alan Walton (Isotopes, Inc., Westwood, N. J.). Jan. 31, 1961. Contract AT(30-1)-2415. 39p.

The variability of Ce^{144} and Sr^{90} concentrations in precipitation at Westwood, N. J. was investigated. Comparison of the Westwood results with the data from other observation stations in the U. S. indicates similar trends in the Ce^{144}/Sr^{90} ratios at all sites, but marked differences in the absolute values of the Ce^{144}/Sr^{90} ratios from one station to another. The general behavior may indicate that increasing quantities of material from the high altitude rocket shots (Teak and Orange) were incorporated in precipitation during the spring of 1960. Calibration errors and errors due to the collection of nuclear debris resuspended in the air from the surface of the earth are considered as possible sources of the differences in absolute values of the measured Ce^{144}/Sr^{90} ratios. Resuspension is shown to be extremely unlikely as an important mechanism. The problem of the negative correlation which was found between the concentration of Sr^{90} in soils and the amount of precipitation at the soil site is considered further. It is shown that the seasonal distribution of precipitation at the various sites is probably of minor importance in producing the above relationship. Several local meteorological parameters, including tropopause height, relative humidity, Showalter Index, and cloud top heights were examined to determine their effect on Sr^{90} concentrations in precipitation; but most show little correlation. One exception, perhaps, is the difference between tropopause heights and the heights of the precipitation cells, which exhibits a fairly good correlation with the Sr^{90} concentration at Westwood, N. J. (auth)

23768 (TID-12616) ATMOSPHERIC RADIOACTIVITY AND FALLOUT RESEARCH. (Division of Biology and Medicine, AEC). Apr. 1961. 76p.

The atmospheric radioactivity and research program of the AEC Division of Biology and Medicine is concerned with the fate and effects on man of radioactive contaminants which may be introduced into the atmosphere as the result of a wide range of peaceful and military applications of atomic energy. Brief summaries are presented of research underway in 1961. Lists of publications resulting from the research program are included. (C.H.)

23769 (WT-811(Del.)) DISTRIBUTION AND CHARACTERISTICS OF FALL-OUT AT DISTANCES GREATER THAN 10 MILES FROM GROUND ZERO, MARCH AND APRIL 1953. Charles T. Rainey, James W. Neel, Harold M. Mork, and Kermit H. Larson (California. Univ., Los Angeles. Atomic Energy Project). Feb. 1954. Decl. with deletions July 1, 1959. Project 27.1 [of] OPERATION UPSHOT-KNOTHOLE. 93p.

Detailed studies were made of the fall-out measurements

made at distances greater than 10 miles from Ground Zero of Shots 2, 3, 4, 5, and 7 of Operation Upshot-Knothole. Shots 2, 5, and 7 resulted in downwind areas of moderate to high-level contamination, with the maximum contamination occurring at 15 miles from Ground Zero of Shot 7; a field dose rate of 1630 mr/hr and a surface contamination of 18,580 $\mu c/ft^2$ were observed at this location. Particle-size studies of settled material indicate an inverse relation between median diameter and distance. Empirical relations derived from the data are presented. (D.L.C.)

23770 (Y-811(Suppl.)) ALKALI METALS AREA SAFETY GUIDE (SUPPLEMENTAL ISSUE). Preston L. Hill (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). May 15, 1961. Contract W-7405-eng-26. 36p.

The Safety Guide was prepared to serve as a reference of basic principles and practices deemed necessary to carry out operations with alkali metals with the least hazard to personnel and equipment. The principles and practices are presented for: indoctrination of employees; general plant safety procedures; personnel safety gear and protective equipment; fire prevention and firefighting; injuries to personnel; opening, repairing, or otherwise servicing tanks, lines, or valves containing alkali metals; handling the alkali metals; disposal of waste materials and alkali metals; cleaning equipment containing alkali metals; operation of valves; correct use of tools; and chemicals, general use. (B.O.G.)

23771 (CEA-tr-A-936) PROTECTION CONTRE LES RAYONNEMENTS ALPHA ET BETA (PROTECTION CONTRE LES RAYONNEMENTS DANS LES REACTEURS ET AU COURS DES MANIPULATIONS NUCLEAIRES). (Protection from Alpha and Beta Radiation (Protection from Radiation from Reactors in the Course of Nuclear Operation)). M. Oberhofer (Oberhaufer) and T. Springer. Translated into French by L. Bory from Kerntechnik, 2: No. 5, 168-9(1960). 9p.

A brief survey is made on protection against alpha and beta radiation. (tr-auth)

23772 SIGNIFICANCE OF HEALTH PHYSICS EVIDENCE IN THE TRIAL OF A CASE OF RADIATION PERSONAL INJURY. H. K. Shapar (U. S. Atomic Energy Commission, Idaho Falls, Idaho). Health Phys., 5: 155-9 (June 1961).

Once health physics data are introduced into evidence, the interpretation of the data becomes the subject of expert testimony—that of the medical and health physics witnesses. The role of the health physics expert witness in conclusions drawn from the data is discussed. Unless the terminology of the trade can be meaningfully translated into clear and understandable equivalents, the value of the health physics data and records may be attenuated or lost. (auth)

23773 THE HEALTH PHYSICIST IN NUCLEAR WARFARE. H. C. Kinne, Jr. (Seventh U. S. Army Training Center, APO 114, U. S. Forces). Health Phys., 5: 173-8 (June 1961).

Radiation sources presented by fall-out or by neutron-induced activity from nuclear weapons may present a hazard different from that considered in industrial health physics. In order to be of maximum assistance under emergency conditions, the health physicist must be familiar with large area, mixed isotope sources and be ready to consider the acute somatic dose with survival as the primary objective. The paper considers the problem of radiation protection under the conditions of nuclear warfare, discusses fall-out, induced activity, the β hazard, and some "rules of thumb" and calculation techniques designed to assist the health physicist in preparing himself. (auth)

23774 DOSIMETRIC INVESTIGATION OF THE YUGOSLAV RADIATION ACCIDENT. G. S. Hurst, R. H. Ritchie, F. W. Sanders, P. W. Reinhardt, J. A. Auxier, E. B. Wagner, A. D. Callihan, and K. Z. Morgan (Oak Ridge National Lab., Tenn.). Health Phys., 5: 179-202 (June 1961).

An investigation of the radiation doses received in the Yugoslav accident on 15 October, 1958, was completed, using modern techniques of dosimetry. The zero power reactor was operated at low power levels to determine the ratio of γ to neutron dose at various locations near the reactor. These measurements were made with special counting methods, one of which measured the neutron dose in the presence of γ rays, and the other measured the γ dose in the presence of neutrons. The reactor was operated at a higher power level for a short time to determine the neutron dose by means of threshold detectors, and the relationship between neutron dose and Na^{24} activation in man-shaped phantoms. A computational program gave theoretical results for the same three quantities. The results of theory and experiment are in good agreement. Final results for the individual doses are given. Of the seven persons investigated, the highest dose received was 436 rads and the lowest dose was 207 rads. The doses previously estimated were reported in rem units, showing for the highest an estimated value of 210 rems for the neutron dose and 630 rems for the γ dose, or a total exposure of 840 rems. (auth)

23775 PARTICLE SIZE STUDIES ON PLUTONIUM AEROSOLS. W. D. Moss, E. C. Hyatt, and H. F. Schulte (Los Alamos Scientific Lab., N. Mex.). Health Phys., 5: 212-18(June 1961).

An α-track technique was used. The sample is collected on a membrane filter and transferred directly to a nuclear emulsion where it is allowed to remain in contact for various time periods. After development of the film, the number of tracks per particle are counted with a microscope. Assuming the particles are spheres of pure plutonium oxide, the particle diameter can be calculated from the number of tracks. Limitations of the technique are discussed. General air samples and breathing zone samples were collected in a processing plant where plutonium metal is handled in glove boxes. The operations conducted in the rooms included metallurgy and machining of plutonium. Particle sizes measured were mostly less than 0.3 μ with standard deviations of the size distributions being less than 2.0. There was very little variation in these parameters from one operation to another. Reasons for these results are presented. The effect of these data on calculated lung deposition and on sampling efficiency with the annular impactor are discussed. (auth)

23776 CONCENTRATION OF URANIUM IN SEA FISH. A. H. W. Aten, Jr., J. W. Dalenberg, and W. C. M. Bakkum (Inst. for Nuclear Physics Research, Amsterdam). Health Phys., 5: 225-6(June 1961).

A concentration factor for uranium between fish and sea water was established. Uranium was determined by uv fluorescence in ash with NaF + 2% LiF. Commercially obtained fish from Amsterdam were used as samples. 2.1×10^{-5} mg u/g was chosen as a reasonable value for the average concentration. Taking a previously determined value by Koczy of 1.1×10^{-8} mg u/ml for surface sea water, a concentration factor of 20 was obtained. (P.C.H.)

23777 A DEVICE FOR DETERMINING THE ORIENTATION OF PERSONS EXPOSED TO NEUTRON AND/OR γ-RADIATION. J. A. Auxier, F. W. Sanders, and P. N.

Hensley (Oak Ridge National Lab., Tenn.). Health Phys., 5: 226-7(June 1961).

Neutron and γ radiation measurements were made with several detectors placed around the waist and chest areas of man phantoms and live burros. Gold and sulfur detectors were used to detect thermal and fast neutrons (>2.5 Mev) and glass dosimeters were used for measuring γ radiation. The results of a typical exposure are shown. For women, the detector stations can be attached inconspicuously inside lab coats by means of iron-on patches. Care and cost of the detectors are also discussed. (P.C.H.)

23778 STRONTIUM-90 IN THE TOTAL DIET. Irving Michelson (Consumers Union of U. S., Inc., Mt. Vernon, New York). Health Phys., 5: 227-9(June 1961).

Total diet samples from 26 cities and milk samples from 8 cities were analyzed. Analytical data are given in terms of Sr^{90} and Ca as well as in Sr units ($\mu\mu c\ Sr^{90}$/g Ca), for both types of samples. The variations in the ratios of Sr units in the total diet to those in milk, ranging from 0.94 to 1.74, indicate that milk is not a reliable index of the Sr unit level of the total diet, and that only total-diet studies will yield good approximation of the Sr^{90} ingested in any given locality. (P.C.H.)

23779 RADIUM-226 IN THE TOTAL DIET. Irving Michelson (Consumers Union of U. S., Inc., Mt. Vernon, New York). Health Phys., 5: 229-30(June 1961).

Total diet samples from five cities were analyzed by the radon-emanation method. The results are given in terms of $\mu\mu c\ Ra^{226}$/kg of total diet and per g of Ca. The total daily intake of Ra^{226} is also presented. Each test was made on a composite of more than 100 foods plus local water. (P.C.H.)

23780 HEALTH AND SAFETY MEASURES IN THE TROMBAY ESTABLISHMENT. A. S. Rao and A. K. Ganguly (Atomic Energy Establishment, Trombay, India). Ind. India, Atomic Energy Suppl., 72-4(Jan. 1961). (In English)

The organization and operation of the Health Physics Division (HPD) of the Atomic Energy Establishment Trombay are outlined. The HPD participates in all atomic energy installation site selections, building designs, and operational procedures. The activities of the HPD in connection with the Canada India Reactor (CIR) are reviewed as an example. Measures at the CIR for control of external and internal radiation hazards are outlined. (T.F.H.)

23781 THE RADIOACTIVITY OF THE PLANKTON OF THE STECHLIN AND NEHMITZ SEAS IN RHEINSBERG (MARK BRANDENBURG). R. Glaser Wissenschaftlich-Technische Büro für Reaktorbau, Berlin-Pankow). Kernenergie, 4: 398-9(May 1961). (In German)

The plankton of the Stechlin and Nehmitz Seas concentrates intensively the fall-out products of atomic bomb experiments from the water. From the isotopic mixture, the activity of Y^{90} can be detected by its short half life and determined separately. The ratio of the enriched fall-out activity to the natural K^{40} activity in the plankton is discussed. (tr-auth)

23782 THE KARLSRUHE INSTALLATION FOR MEASURING THE RADIOACTIVITY IN PERSONS (ALLBODY COUNTERS). H. Kiefer and R. Maushart (Strahlenmessabteilung des Kernforschungszentrums, Karlsruhe, Ger.). Kerntechnik, 3: 228-31(May 1961). (In German)

After a short survey of the various types of whole-body counters, the construction, organization, and capacity of the Karlsruhe installation which was put into operation in January are described. (auth)

23783 ON THE TREATMENT OF THE DEAD BODY IN WHICH RADIOISOTOPE ADMINISTERED INTERNALLY STILL REMAINS. T. Sunada, M. Kinoshita, S. Kinoshita, K. Hattori, and K. Nishioka (Osaka Univ. Medical School and Radiation Center of Osaka Prefecture). Med. J. Osaka Univ., 11: 303-8(Dec. 1960). (In English)

It is suggested that a record of the dose, kind, and date of radioisotope administered should be kept by a patient and, in case of death, given to the autopsy surgeon and undertaker. Possible hazards from radioactive corpses in Japan are discussed. It is pointed out that a wake is often held in a small room and that cremation of the body is customary. (C.H.)

23784 BACK-SCATTER IN CONTACT AND SUPERFICIAL THERAPY WITH STRAIGHT-FROM-THE-HAND IRRADIATION. G. J. van der Plaats, Jr. (St. Annadal Hospital, Maastricht, Netherlands). Med. Mundi, 7: No. 1, 22-30(1961).

The advantages of straight-from-the-hand irradiation are discussed along with the backscatter radiation danger for the person giving the treatment. The quality and quantity of the scattered radiation at the hand grip level were measured at different voltages (20 to 50 kv) and with extra filters (0 to 2 mm Al), with a water phantom and with patients. Results are compiled in tabular form. Protective measures for the reduction of the backscattered radiation dose are also discussed. (P.C.H.)

23785 RELIABILITY OF THE FILM BADGE METHOD FOR DOSE MEASURING (ENGLISH TEXT). T. Kitabatake, T. Watanabe, and M. Yato (Nagoya Univ., Japan). Nagoya J. Med. Sci., 22: 229-34(1959).

The possibility of measuring the x-ray dose exactly with the film-badge method and an estimation of errors to be expected in clinical use were studied. Experiments were performed using both badge-film and -case made in Japan. The badge-case employed had 4 different filters, A, B, C, and D, on the front of the case. A: no filter, B: 1 mm. Al, C: 0.8 mm Al + 0.2 mm Cu, and D: 0.6 mm Al + 0.4 mm Cu filters. Density of the films was measured by a Yamanobe-type densitometer. On the film over 0.3 in density, about 10% of error resulted. The characteristic curve of density was plotted with 12% of error. The margin of error in establishing the x-ray dose received took several different values according to energy dependence. Reduction of density due to direction dependence was discussed experimentally. For relatively reliable values of dosage, B/C was most useful in the range of wave lengths of x ray applied in diagnosis, if irradiated to over 0.2 r. (Absts. Japan. Med., 1: No. 6, 1961)

23786 IRON-55 FROM NUCLEAR DETONATIONS. Rama, Minoru Koide, and Edward D. Goldberg (Univ. of California, San Diego). Nature, 191: 162(July 8, 1961).

The livers and hearts of tuna fish collected from the Pacific Ocean were analyzed for Fe^{55} content as an indication of fall-out radioactivity. The specific activity of the samples, in Feb. 1961, was found to be 82000 dpm/gm of Fe. Values were calculated for the specific activity of oceanic Fe. Measurements were also made of Fe^{55} activity in samples of ocean sediment and rain water from San Diego. Results indicate that the present contribution of atmospheric fall-out is small compared with the total inventory of the ocean, and the activity level of Fe^{59} in the ocean is not great enough to constitute a health hazard. (C.H.)

23787 SAFETY CONTROL AND MONITORING IN A URANIUM FACTORY. Y. Mizutani (Nagoya Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1956-61(1959).

External irradiation dosage from uranium ingots was below the maximum permissible dose, unless the worker was in contact with the metal. Uranium concentration in air near the worker's mouth was below one-tenth the maximum permissible concentration, as measured by the dust-monitor. Average uranium in the waste water was about 300 μg/l, nearly $\frac{1}{20}$ of the maximum permissible concentration. Under present exhaust and uranium-treating systems in refining about 80 kg of uranium metal per day the employees are exposed to radiation below the maximum permissible dose. (Absts. Japan. Med., 1: No. 6, 1961)

23788 HEALTH CONTROL OF URANIUM FACTORY WORKERS. Y. Mizutani (Nagoya Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 1962-6(1959).

Of 37 workers in a certain uranium milling factory in Nagoya, physical examinations, chest x rays, liver function tests, urinalysis, blood pressure measurements, and hematological examinations were carried out 4 times during 2 years. As uranium toxicity is considered to consist of chemical and radiation injury and pneumoconiosis, the chest x ray, urinalysis, blood pressure, and hematological examination were considered of great importance for early diagnosis. Neither occupational radiation injuries nor uranium intoxication were detected, perhaps because of the present small scale of operation in the plant. (Absts. Japan. Med., 1: No. 6, 1961)

23789 PROBLEMS OF THE PROTECTION AGAINST RADIATION IN INDUSTRY. Nedžib Šaćirbegović (Institut za Higienu, Sarajevo, [Yugoslavia]). Nova Proizvodnja, 11: 236-41(1960). (In Yugoslavian)

Protection against radiation in industry is discussed in terms of medical and physical technical protection. Medical protection controls are for assuring the employment of exposed and unexposed workers. The physical technical protection group assures safe working conditions. This latter group measures the degree of exposure, examines the physical conditions of the people, inspects working shops, and investigates atmospheric conditions. A discussion of rules is also presented. (N.W.R.)

23790 THE X- OR GAMMA-RAY ENERGY ABSORPTION OR TRANSFER COEFFICIENT: TABULATIONS AND DISCUSSION. Rosemary T. Berger (National Bureau of Standards, Washington, D. C.). Radiation Research, 15: 1-29(July 1961).

The x- or γ-ray energy absorption coefficient is given a careful definition, and a new name, energy transfer coefficient, which is more descriptive of the definition is suggested. The significance of the energy transfer coefficient for calculating absorbed dose is discussed, and a tabulation is given of energy transfer coefficients for various materials for photon energies between 3 kev and 10 Mev. This tabulation is a revision and extension of previous work of G. R. White Grodstein and takes into account the latest values of the relevant cross sections. Limitations and uncertainties of the tabulated values are discussed. Auxiliary data are given of the parameters (such as cross sections and conversion factors) which enter into the calculation of the energy transfer coefficient to enable the reader to construct energy transfer coefficients with correction terms appropriate to a particular application. 38 references. (auth)

23791 ABSOLUTE MEASUREMENT OF THE DOSE UNIT "r" IN THE ENERGY RANGE FROM 0.2 TO 3 Mev. Andreas Sewkor (Max-Planck-Institut für Biophysik, Frankfurt am Main). Strahlentherapie, 115: 22-32(May 1961). (In German)

The measurement of the dose constant of radium in equilibrium with its end-products was resolved experimentally as well as by calculation. The experimental measurement was carried out in a free air room, 26 × 24 × 22 m, at different distances between radiation source and ionization chamber. The manufacture of both ionization chambers is described. The result of measuring was $8.13 \pm 0.2 r \cdot cm^2 \cdot h^{-1} \cdot mg^{-1}$. The result of the calculation was $8.30 \pm 0.4 r \cdot cm^2 \cdot h^{-1} \cdot mg^{-1}$. Apart from this it was shown that through the exact measurings of the scatter-radiation addition the total absorption coefficient of the primary gamma rays for air can be ascertained. The value of the total absorption coefficient for air was $\mu = (7.27 \pm 0.5) \cdot 10^{-5}$ l/cm. (auth)

23792 WATER SUPPLY IMPLICATIONS AND METHODS OF REMOVAL. Conrad P. Straub (Robert A. Taft Sanitary Engineering Center, Cincinnati). Univ. Illinois Circ. 58: No. 83, Eng. Expt. Sta., Circ. No. 69, 34-41(July 1961).

After a brief review of beta and Sr^{90} activity levels from fall-out in rain, rivers, and cisterns over the entire U. S., the significance of radioactivity levels is discussed. General considerations relating to water decontamination are given. The removal of radioactive materials by conventional water treatment processes and modified processes, Sr^{90} by lime-soda ash treatment, and fission products by various treatments is described. The importance of decontaminating water supplies by the best method possible is stressed. (P.C.H.)

23793 MONITORING THE RADIOACTIVITY IN CHICAGO WATER SUPPLY. James C. Vaughn (Dept. of Water and Sewers, Chicago). Univ. Illinois Circ. 58: No. 83, Eng. Expt. Sta., Circ. No. 69, 72-8(July 1961).

Studies initiated in 1949 to develop basic data on the natural background levels of radioactivity in uncontaminated Lake Michigan water have been continued to the present with modifications and expansions. The monitoring program is divided into 3 phases: continuous monitoring, regular sampling and counting of rain and treated water, and sampling and counting of precipitation such as rainfall or snow. Yearly gross radioactivity of rain, lake, and outlet water is tabulated for the years 1956 to 1959 along with the same tabulation for each month of 1959. An evaluation of the types and costs of equipment used is also given. (P.C.H.)

23794 PROCEEDINGS, SECOND SANITARY ENGINEERING CONFERENCE, RADIOLOGICAL ASPECTS OF WATER SUPPLIES, JANUARY 27 AND 28, 1960, URBANA, ILLINOIS. Univ. Illinois Circ. 58: No. 83, Eng. Expt. Sta., Circ. No. 69, 80p.(July 1961).

Fifteen papers are included; separate abstracts have been prepared for 5. One paper was previously abstracted in NSA. The remaining papers deal with the physiological and environmental aspects of radiation, monitoring problems, monitoring experience in Illinois, a survey of radiation detection instruments, and the preparation of samples for radioactivity counting. (P.C.H.)

23795 FUNDAMENTAL AND CLINICAL ASPECTS OF RADIATION PROTECTION AND RECOVERY. With Special Emphasis on Chemical Protection and Bone Marrow Transplantation in Mammals. No. 3: 1960. (Oak Ridge National Lab., Tenn.). 22p. Free (ORNL).

Three conferences were held in 1960 on the fundamental and clinical aspects of radiation protection and recovery; one at Oak Ridge, Tenn., on Jan. 8 and 9, a second at the Federation Meetings in Chicago on April 11, and the third in Boston at the Cancer Research Institute, New England Deaconess Hospital, Nov. 18 and 19. Emphasis was placed on chemical protection of radiation injuries and bone mar-

row transplantation in mammals. Brief summaries are presented of the discussions at these meetings. (C.H.)

23796 IONIZING RADIATION AND HEALTH. Bo Lindell and R. Lowry Dobson (World Health Organization, Geneva). World Health Organization Public Health Papers No. 6. 1961. 81p.

Present knowledge on radiation and health is brought together. There are sections on the biological effects of ionizing radiation, the interpretation of physical levels, current radiation protection work, and the present radiation pattern as described in physical terms. A glossary of technical terms is appended. (auth)

23797 RADIOLOGICAL HEALTH DATA MONTHLY REPORT, MAY 1961. Volume II, No. 5. (Public Health Service, Washington, D. C.). 30p. $0.50(GPO).

Data are tabulated on the radioactivity in samples of air, milk, surface water, drinking water, foods, and bone collected throughout the United States and Canada between Sept. 1960 and Jan. 1961. Data are included on environmental levels of radioactivity in the vicinity of major Atomic Energy Commission installations during the 2nd and 3rd quarters of 1960. (C.H.)

23798 RECOMMENDATION CONCERNING THE PROTECTION OF WORKERS AGAINST IONISING RADIATIONS. Recommendation 114. Presented at International Labour Conference, Forty-fourth Session, June 1960, Geneva. Geneva, International Labour Office, [1960]. 5p. $0.05; 3d.

Methods are recommended for protection, monitoring, medical examinations, and the cooperation of employers and workers. (P.C.H.)

23799 CONVENTION CONCERNING THE PROTECTION OF WORKERS AGAINST IONISING RADIATIONS. Convention 115. Presented at International Labour Conference, Forty-fourth Session, June 1960, Geneva. Geneva, International Labour Office, [1960]. 5p. $0.05; 3d.

General provisions are given concerning rules for workers who join the convention and for protective measures requested for the benefit of member workers. (P.C.H.)

23800 REGULATIONS FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIALS. Safety Series No. 6. (International Atomic Energy Agency, Vienna). 1961. 76p. (STI/PUB/40)

Safety regulations are proposed that can be applied to the national and international transport of radioactive materials by all means. (C.H.)

23801 IMPROVEMENTS IN RADIATION SHUTTERS. (to Fairchild Camera and Instrument Corp.). British Patent 872,920. July 12, 1961.

An apparatus for the protection of eyesight from the radiated energy released from a thermonuclear explosion is described. The apparatus consists of a shutter which is opaque to the radiation, an electrically ignitible detonator for blowing the shutter across the path of the radiation, and a phototransistor for igniting the detonator when the radiated energy exceeds a level which is injurious to the eyesight. There may be a second detonator for blowing the shutter away after the explosion has subsided. The second detonator is manually operated. Diagrams show the apparatus attached to a soldier's helmet and a turret. (N.W.R.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

23802 (AD-251514) INCREASING THE ACCEPTANCE OF IRRADIATED MEAT AND MEAT PRODUCTS BY SELECTED TREATMENTS BEFORE, DURING AND FOLLOWING IRRADIATION. Report No. 15 (Progress) [for] January 27, 1960–April 26, 1960. W. H. Schultz (Oregon State Coll., Corvallis and Oregon. Agricultural Experiment Station, Corvallis). Contract AD-19-129-QM-836. 10p.

Ground beef was heated for varying time/temperature periods, irradiated, and stored at 70°F. The increase in nitrogenous constituents is being analyzed. Results again point to the necessity of heating meat to at least 160°F internal temperature to reduce enzymatic action. Salt increased the water holding capacity of the meat and apparently enhances the liberation of tyrosine. Dextrose treated steaks indicated some superiority in texture. (auth)

23803 (AD-251586) RESISTANCE OF MICROORGANISMS TO IONIZING RADIATION APPLIED TO FOOD. Report No. 1 (Progress) [for] January 2, 1960–March 31, 1960. A. W. Anderson (Oregon State Coll., Corvallis and Oregon. Agricultural Experiment Station, Corvallis). Contract DA-19-129-QM-1517. 4p.

No viable cells or toxin production could be demonstrated in ground round beef inoculated with 1×10^6 spores/gram Cl. botulinum strain 5A and irradiated to 2.5 or 3 megarad in the presence of 3% salt. Tests in progress include the use of various spices and chemical additives to determine their effect upon cells in the presence of γ rays. (auth)

23804 (AD-251622) DEVELOPMENT OF RATION TYPE PORK ITEMS. Report No. 1 (Progress) [for] January 15, 1960–May 15, 1960. V. J. Kubala (Armour and Co. Food Research Dept., Chicago). Contract DA-19-129-QM-1541. 3p.

Pork loins were injecto cured with a 40° base brine solution containing various additives. Also, a test was conducted whereby 10% vegetable extract was injecto pumped into boneless pork loins. The loins were roasted to inactivate the enzymes, sliced, and vacuum sealed in 401 × 411 cans and irradiated at a 4.5 megarad level. The three irradiated lots prepared were organoleptically compared with a heat sterilized control. A sixteen member panel rated the samples on an eight point hedonic scale and the quick test of Kramer was used to determine whether or not any significant differences existed. Statistical analyses show that there was no significant difference between the samples. Further organoleptical examinations will be held in the near future. (auth)

23805 (AD-251798) STUDY ON COMMERCIAL LIKE STORAGE OF IRRADIATED POTATOES. Report No. 1 (Progress), October 1, 1959–March 31, 1960. Miles Willard (Rogers Bros. Seed Co., Idaho Falls, Idaho). Contract QMR&E (NATICK) No. 133 (Agreement). 3p.

Bags of commercial potatoes were irradiated with 7.5×10^3 rads and stored in a typical commercial storage cellar or under refrigeration from Jan. to April. Periodic inspections and observations showed no visible differences between irradiated and non-irradiated potatoes. Diced potatoes made from the irradiated potatoes had a grey discoloration sufficient to make them unacceptable for commercial use. (C.H.)

23806 (NP-9577) THE CARCINOGENIC PROPERTIES OF IRRADIATED FOODS. Progress Report No. 6, March 1, 1960–September 1, 1960. J. C. Calandra and John H. Kay (Industrial Bio-Test Labs., Inc., Northbrook, Ill.). Contract DA-49-007-MD-895. 20p.

A test diet composed of six irradiated foods was fed to two strains of mice. Growth, mortality, and tumor incidence are being investigated. Mean body weights and mortality rates were calculated for both strains. Results so far indicate no significant body weight differences between control and test mice. Over-all mortality per test or control group varied from 21 to 22% for one strain and 20 to 38% for the other. Thus far none of the deaths are definitely correlated with ingestion of the test or control diet. No significant data concerning tumors are available. (P.C.H.)

23807 (NP-9580) THE EFFECT OF CONTROL-GROUND BEEF AND IRRADIATED 5.58 MEGARAD-GROUND BEEF CONSUMPTION ON REPRODUCTIVE PERFORMANCE IN THE BEAGLE. Progress Report No. 1 for Period Ending Sept. 15, 1960. Thomas B. Clarkson and John C. LeMay (Wake Forest Coll., Winston Salem, N. C. Bowman Gray School of Medicine). 4p. Contract DA-49-193-MD-209A.

Body weight gains and food consumption data are calculated. Hematological and urine analyses were made during the initial course of the project. No significant differences on values were obtained. At this time no information concerning reproductive performance is available. (P.C.H.)

23808 (NP-9581) PROGRESS REPORT ON MOUSE CARCINOGENICITY STUDY. Report Covers Period: March 1, 1957–September 15, 1960. J. L. Radomski (Miami. Univ., Coral Cables, Fla. School of Medicine). Contract DA-49-007-MD-789. 11p.

No significant difference in tumor incidence was observed in mice maintained for life on a diet if irradiated foods and those maintained on a normal diet. (C.H.)

23809 (NP-9583) LONG-TERM DOG AND RAT FEEDING EXPERIMENT EMPLOYING IRRADIATED MILK AND BEEF STEW (C-RATION). Progress Report No. 7, March 1, 1957–September 15, 1960. William B. Deichmann (Miami. Univ., Coral Gables, Fla. School of Medicine). 18p. Contract DA-49-007-MD-785.

Feeding irradiated evaporated milk and irradiated beef stew to rats and dogs for two years did not produce histopathological changes ascribable to the consumption of irradiated food. (C.H.)

23810 (TID-13024) INVESTIGATION OF THE EFFECTS OF IONIZING RADIATION ON THE SEDIMENTATION OF SEWAGE. Second Quarterly Report. (Universal Match Corp., [Ferguson], Mo.). June 1, 1961. Contract AT(11-1)-905. 28p. (UMC-F61-130)

The water pollution problem is discussed briefly. An evaluation of methods of measuring settling variables indicate that optical density (turbidimetric) or light scattering (nephelometric) methods are the most practical approach. Representative suspensions of bentonite and

oil-coated fuller's earth samples of synthetic sewage and river water were irradiated by a source with an average dose rate of 1100 r/min; slight increases in sedimentation were noted at doses of 10^6 rads. A 2,000-curie Co^{60} irradiation facility being constructed for further sedimentation studies is described. (D.L.C.)

23811 (NP-tr-690) THE TREATMENT OF WHEAT WITH IONISING RADIATION. PART I. EFFECT ON THE MILLING QUALITIES IN HARD WINTER WHEATS. W. Seibel. Translated by F. Hudswell for U.K.A.E.A., Atomic Energy Research Establishment from Getreide u Mehl, 10: 13-16(1960). 16p. (Includes original, 1p.)

A mixture of varieties of hard winter wheats was irradiated with doses of 0 to 3 Mrep. Investigations of effects on milling qualities led to several conclusions. The flour yield, ash content, and ash merit index do not change with radiation intensity. No differences were recognized in the analytical composition of the by-products. The color of the flour is worsened as a result of γ irradiation; the power requirement decreases as the radiation dose increases. Aside from the latter no positive effect due to γ irradiation was ascertained concerning the milling qualities. Differences in regard to fineness of the test flours were not established. (P.C.H.)

23812 (NP-tr-696) THE TREATMENT OF WHEAT WITH IONIZING RADIATION. PART II. THE EFFECT ON THE PENTOSANS AND BAKING PROPERTIES OF HARD WINTER WHEAT. F. K. Finney, M. Milner, and W. Seibel. Translated by A. Schoenfeld for U.K.A.E.A. Atomic Energy Research Establishment from Getreide u Mehl, 10: 16-20 (1960). 20p. (Includes original, 2p.)

Hard winter wheat was irradiated with various doses of γ radiation. Where the ash and protein content remains the same, the pentosan content of flour and coarse and fine bran also remains unchanged. Coarse bran shows the highest total pentosan content; flour the lowest. Under irradiation the soluble pentosan fraction increases and at 3 mrep reaches the following values: flour 43.8%; fine bran 17.2%; and coarse bran 8.1%. At radiation intensities of 0.5 mrep, the soluble pentosans lose their ability to form gels with the addition of oxidizing agents, and the gas-retaining property of the dough becomes permanently weaker. Radiation causes color and flavor deterioration in the flour that is also perceptible in the baked product. In the test baking, the water absorption and kneading time fall with increased radiation doses, and the crumb value also deteriorates. No improvement of the baking properties was observed after irradiation. (P.C.H.)

23813 OUR EXPERIENCES GAINED BY APPLICATION OF THE GAMMA-RAYS IN THE INDUSTRY OF THE FOODSTUFFS. Marta Blinc, J. Brank, and E. Nemec (Kmetijski Institut "Boris Kidric," Ljubljana, Yugoslavia). Nova Proizvodnja, 11: 280-8(1960). (In Yugoslavian)

Preservation of foodstuffs with gamma radiation is discussed. By irradiating pork, veal, and poultry meat with 1,000,000 to 2,000,000 rep in combination with sodium glutamate (0.5% solution), the meat can be stored at 1 to 2°C for a period of 3 to 6 weeks. Frankfurter sausages, liver pie, and beef may be stored under the same conditions for 20 days. Vegetables may be stored even longer under the same temperature conditions and at lower dosages (3000 to 300,000 rep). A discussion is also presented on the industrial preservation of those foods which can be preserved by doses of 0.25 Wh/kg and under. (N.W.R.)

23814 IRRADIATING AN OBJECT. (to High Voltage Engineering Corp.). British Patent 872,517. July 12, 1961.

A method and apparatus for irradiating separate objects or packagings such as bottles, ampoules, vials, or collapsible containers with high-energy electrons from a single electron accelerator are described. The apparatus consists of an electron accelerator adapted to produce a stream of high-energy electrons by impairing a scanning movement to a beam from a single electron source. There are means for supporting the objects to be irradiated in the path of the stream in such manner that a portion of the stream passes the objects without striking them. There is also a magnet with an air gap through which the portion of the stream travels. The magnet is constructed and arranged so that the portion of the stream may be redirected on to an unirradiated surface of the objects. (N.W.R.)

23815 APPARATUS FOR IRRADIATING CONTINUOUS LENGTHS OF MATERIAL. (to High Voltage Engineering Corp.). British Patent 872,518. July 12, 1961.

An electron accelerator for irradiating continuous lengths of material, such as plastic tubing, cables, and insulated wire, with high-energy electrons is described. The accelerator is adapted to produce a beam of electrons whose cross section is extended in at least one plane. There are means for producing two substantially oppositely oriented magnetic fields in the path of the beam such that the electrons converge toward an irradiation zone. Support means for holding the material in the irradiation zone are also described. (N.W.R.)

ISOTOPE SEPARATION

23816 (NP-9592) EXPERIMENTAL AND THEORETICAL THERMAL DIFFUSION FACTORS IN BINARY AND TERNARY MIXTURES (Thesis). Manuel Fernandes Laranjeira (Leiden. Universiteit). 1959. 148p.

Following the lines of a free path treatment of diffusion, a general equation is presented which takes into account concentration and thermal and pressure diffusion. Multicomponent mixtures were also considered. Observations were carried out with the mixtures (He^4; Ar^{36}, Ar^{40}), (He^4; Ne^{20}, Ne^{22}), (H_2; Ne^{20}, Ne^{22}), and also with Ne–Ar regarded as a multicomponent mixture. The linear dependence predicted by the theory was observed for all the inverses of nonisotopic thermal diffusion factors and for the inverse of the isotopic thermal diffusion factor also except for Ne^{20}–Ne^{22} in the Ne–Ar mixtures. The thermal diffusion factor of Ar isotopes Ar^{36}–Ar^{40} increases in He–Ar and Ne–Ar mixtures, with increased concentration of He and Ne. Marked decrease was observed for the thermal diffusion factor of Ne^{20}–Ne^{22} with increased concentrations of He, H, and Ar, and a change of sign was observed for α 20.22 (exp) in Ne–Ar mixtures. (P.C.H.)

23817 (AEC-tr-4055(p.331-7)) ENRICHMENT OF RADIOACTIVE ISOTOPES OF CHROMIUM BY USE OF THE HEXACARBONYL. M. A. Toropova. Translated from Zhur. Neorg. Khim., 2: 1201-4(1957).

A method of enriching Cr in Cr^{51} by means of the Szilard-Chalmers reaction with Cr hexacarbonyl is outlined. In this method, the Cr hexacarbonyl is irradiated in $CHCl_3$ with slow neutrons and the resulting Cr^{51} separated by extraction with HCl solution. The enrichment factor was measured to be 1.7×10^4 at a Cr^{51} yield of 30%. Studies of the forms of Cr^{51} show that more than 85% of Cr^{51} is in the form of Cr^{3+}. (D.L.C.)

23818 (CEA-tr-A-950) ESSAIS DE SEPARATION DES ISOTOPES DU CALCIUM PAR ANALYSE RADIOMETRIQUE PAR ADSORPTION. (Experiment on Separation of Calcium Isotopes for Radiometric Analysis by Adsorption). R. Lindner. Translated into French by P. Monnard from Z. Naturforsch., 9a: 798(1954). 3p.

Various experiments on the isotopic separation of calcium using ion exchange resins are described. In a typical study $CaCO_3$ dissolved in HCl is fed into an ion exchange column charged with H^+. At a temperature of 95°C the calcium is eluted with 5% ammonium citrate. The retention factor is 0.06. The calcium was received in fractional eluates and can be precipitated from the various fractions. (J.S.R.)

23819 (IA/588-tr) PHASE EQUILIBRIA AND ISOTOPE SEPARATION. Istvan Kiss. Translated by A. Szoke and H. Szoke from Fiz. Szemle, 10: No. 10, 230-?(1960). 17p.

Isotope effects appearing at phase equilibrium which may serve as the basis for isotope separation are discussed. The strength of the isotope effect is measured by the enrichment or separation factor. The enrichment factors for several light elements on distillation are given. The temperature dependence of these factors and attempts to explain the inverse effect observed for some are discussed. Experimental methods for the determination of isotope pressure differences are described. Recent studies of isotope separation in liquid-liquid and liquid-solid phase equilibria are summarized. (M.C.G.)

23820 IMPROVEMENTS IN OR RELATING TO DISTILLATION COLUMNS. Allan Barker (to United Kingdom Atomic Energy Authority). British Patent 870,626. June 14, 1961.

The design of a column for the distillation of boron trifluoride in order to separate the boron-10 and boron-11 at low temperatures (–100 to –127°C) is described. The column contains a condenser at the top. The condenser contains a condensing surface separated from a coolant storage chamber by a heat transfer path arranged to be swept by coolant vapor from the storage chamber. The column is packed with gauze rings. (N.W.R.)

23821 IMPROVEMENTS IN OR RELATING TO THE SEPARATION OF THE ISOTOPES OF LITHIUM. Eichi Saito (to Commissariat a l'Energie Atomique). British Patent 872,343. July 5, 1961.

A process for the separation of the isotopes of lithium by chemical exchange between lithium amalgam and an organic solution of a lithium chloride or bromide is described. Lithium amalgam produced by an electrolysis cell with a mercury cathode is brought into intimate contact with the organic solution containing the lithium salt in a countercurrent contact apparatus. Then the lithium amalgam leaving the contact apparatus is treated with an aqueous solution of the acid corresponding to the lithium salt. The mercury freed from the lithium amalgam treatment is passed back to the electrolysis cell. The lithium salt formed simultaneously by the same treatment is evaporated and dissolved in either dimethyl formamide or tetrahydrofuran. This organic solution is also a part of the feed. The organic solution is distilled as it leaves the contact apparatus. The distilled organic solvent is condensed and collected. The solid lithium salts obtained so far are dissolved in water and are passed to the electrolysis cell. Li^6 may be extracted between the exit of the lithium amalgam from the contact apparatus and the input of the organic solution into the contact apparatus. Li^7 is extracted between the exit of the organic solution from the contact apparatus and the input of the lithium amalgam into the contact apparatus. (N.W.R.)

MATHEMATICS AND COMPUTERS

23822 (AFCRL-648) MONTE CARLO APPLICATION TO MOLECULAR FLOWS. Laboratory Report No. 61-5. J. K. Haviland (Massachusetts Inst. of Tech., Cambridge. Fluid Dynamics Research Lab.). May 1961. Contracts AF19(604)-5698 and AF49(638)-207. 320p.

A Monte Carlo method for the solution of the Boltzmann equation, so that numerical results would be available for comparison with analytical solutions from the literature was developed. Two problems were selected for study. The first was the heat flow of a monatomic gas, either hard sphere or Maxwellian, between two parallel plates. The second was the normal shock wave. Programs were prepared for the IBM 709, and solutions were obtained as follows: one heat flow solution for hard spheres at a Knudsen number of 2.0, and at a temperature ratio of 4:1 between the plates; two heat flow solutions for Maxwellian molecules at Knudsen numbers of 0.53 and 1.64, and a temperature ratios of 4:1; three shock wave solutions at Mach numbers of 1.5, 2.0, and 3.0. In addition, new analytical solutions were obtained to the heat flow problem, using a four-moment full range method for hard sphere molecules, and a six-moment full range method for Maxwellian molecules. In both cases, the moment equations were derived from the non-linear Boltzmann equation, so that results were not restricted to small temperature differences. The Monte Carlo results in the heat flow problem were not in good agreement with the four-moment full range solutions for Maxwellian or hard sphere molecules, nor did the six-moment Maxwellian solutions indicate any distinct improvement over the corresponding four-moment solution. The Monte Carlo results did show good agreement with certain linearized solutions from the literature, and suggest that the more refined linearized solutions may still be valid at large temperature differences. The Monte Carlo results in the shock wave case tended to substantiate the results of a bimodal two-fluid analysis from the literature. (auth)

23823 (AFOSR-781) ASYMPTOTIC BEHAVIOUR AND SUBTRACTIONS IN THE MANDELSTAM REPRESENTATION. Marcel Froissart (California. Univ., Berkeley). [1958?]. Contract AF 49(638)-327. 19p.

It is proved that a two-body reaction amplitude involving scalar particles and satisfying Mandelstam's representation is bounded by expressions of the form $C\ s\ \mathrm{Log}^2\ s$ at the forward and backward angles, and $C\ s^{\frac{1}{4}}\ \mathrm{Log}^{\frac{1}{2}}\ s$ at any other fixed angle in the physical region, C being a constant, s being the total squared cm energy. This corresponds to cross-sections at most like $\mathrm{Log}^2 s$. The restrictions limit the freedom of choice of the subtraction terms to six arbitrary single spectral functions and one subtraction constant. (auth)

23824 (GAT-297) INCREMENTAL POWER DEMAND COMPUTER. R. F. Roe, R. L. Farr, and H. Steinhauer (Goodyear Atomic Corp., Portsmouth, Ohio). Dec. 1, 1960. Contract AT(33-2)-1. 15p.

An Incremental Power Demand Computer (IPDC), which measures consumed electric energy at 6-min intervals, was constructed to replace the Power Demand System (PDS), which prints the energy level once an hour, in the Portsmouth Area Gaseous Diffusion Plant. The width of the operating band over a 16-day period was 2.77 Mw for IPDC and 6.61 Mw for PDS. An average increase in plant load of 1 to 1.5 Mw without frequently exceeding the desired load level should be possible. (D.L.C.)

23825 (HW-SA-2199) FURTHER ASPECTS OF A MULTICOMPARTMENT MIGRATION MODEL. A. D. Wiggins (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1, 1961. Contract AT(45-1)-1350. 16p.

The results of Bernstein are extended from one dimension to K dimensions. The possibility of an independent source within each compartment is considered. (D.L.C.)

23826 (JINR-P-296) O VYCHISLENII POVTORNYKH INTEGRALOV METODOM MONTE-KARLO. (Calculations of the Multiple Integrals by Monte-Carlo Method). Yu. N. Blagoveshchenskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1959. 5p.

It is shown that the method suggested by Yu. N. Blagoveshchenskii and G. I. Kopylov ("Calculations of Statistical Weights by Monte Carlo Method." Joint Inst. of Nuclear Research 1958, p.213) is the most practical and efficient of the Monte Carlo Methods for calculating multiple integrals. (R.V.J.)

23827 (LAMS-2522) THE POT CODE. Clarence E. Lee (Los Alamos Scientific Lab., N. Mex.). Aug. 1960. Contract W-7405-Eng-36. 45p.

A description is given of a code, the POT code, which is designed to transcribe the output tapes of LB-1 and LB-2 into a standard input tape from which neutron transport calculations can be performed by the TOP code (LAMS-2523). (auth)

23828 (ORNL-3132) POLFIT II, AN IBM 7090 PROGRAM FOR POLYNOMIAL LEAST SQUARES FITTING. M. P. Lietzke (Oak Ridge National Lab., Tenn.). Apr. 24, 1961. Contract W-7405-eng-26. 27p.

A program was written to perform polynomial least squares fits on the IBM 7090 computer. Weighting factors may be included with the data if desired. The program includes a subroutine which does the fit and furnishes the calling program with the coefficients, standard errors in the coefficients, standard error of fit, and information necessary to compute a complete error analysis; and a calling program which reads input, calls the subroutine, and writes requested output. The subroutine may be used separately in any Fortran or FAP program where a least squares fit is needed. (auth)

23829 (UCRL-5206-T) "SHARP"—A ONE-DIMENSIONAL HYDRODYNAMICS CODE FOR THE IBM 704. Olen Nance, Mark Wilkins, Isabel Blandford, and Hugh Smith (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 1958. Contract W-7405-eng-48. 22p.

The SHARP code designed to handle calculations of hydrodynamic motion in one-dimensional form, including provision for the disruption of the sample by spallation, is described. The code was prepared by means of the IBM logical coding scheme, FORTRAN. Generation of SHARP requires a set of initial conditions which define an established pressure pulse in the front portion of the sample. The code was developed to investigate the motion of the pressure pulse and the corresponding effects. The input for the code consists of the location and velocity of zone boundaries, values of the internal energy and relative volumes of active zones, the density of the material, and the constants required to establish the equation of state. (M.C.G.)

23830 TIME DISTRIBUTION ANALYSIS RELATED TO STATISTICAL PHYSICS. A. de Moraes and P. A. Pompeia (Universidade, Sao Paulo, Brazil, and Instituto Technologico de Aeronautica, San Jose dos Campos, [Brazil]). Anais acad. brasil. cienc., 33: No. 1, 13-23(1961). (In English)

A statistical criterion is proposed for the type of problems which involve the question of whether events happen at random or are caused. A known method of attacking the problem of a succession of events of the same type, which occur in a definite time interval, may be used. A second statistical method is also introduced in the following way: (a) definition of a general criterion of distribution; (b) calculation of the probability of a given distribution; (c) investigation of the most probable distribution; and (d) calculation of the ratio between the probability of this most probable distribution and that of the distribution obtained in an experiment. (L.N.N.)

23831 ON A NEW COMPUTATIONAL SOLUTION OF TIME-DEPENDENT TRANSPORT PROCESSES. I. ONE-DIMENSIONAL CASE. Richard Bellman, Robert Kalaba, and Marcia Prestrud (RAND Corp., Santa Monica, Calif.). Proc. Natl. Acad. Sci. U. S., 47: 1072-4(July 1961).

A method is discribed for inverting the Laplace transform numerically in the transformation of linear functional equations subject to boundary conditions into nonlinear functional equations subject only to initial conditions in space and time coordinates. The method was applied in a study of the reflected flux from a one-dimensional rod for the case of neutron transport. Equations are presented. (C.H.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

23832 (AD-237163) HANDBOOK OF SOVIET ALLOY COMPOSITIONS. (Armed Services Technical Information Agency, Arlington, Va.). Aug. 25, 1959. 245p.

A handbook is presented which identifies Soviet metal and alloy designations and their corresponding composition ranges. In general, applications are not considered. The data are tabulated. (J.R.D.)

23833 (AFOSR-TN-60-791) FLOATING ZONE REFINING OF BORON USING ELECTRON BEAM MELTING. M. O. Thurston and C. B. Hood (Ohio State Univ. Research Foundation, Columbus). May 1961. Contract AF49(638)-424. 11p.

Boron rods, prepared by the reduction of boron trichloride with hydrogen, were refined by the floating zone process. The melting was accomplished by electron bombardment, using a 300 v, 0.2 amp beam. The band gap for a zone refined sample after three passes was 1.30 ev as determined from resistivity measurements. It was observed that carbon is an electrically active impurity, and that nickel and tungsten are not. (auth)

23834 (BM-IC-7953) BIBLIOGRAPHY ON METALLURGY OF HIGH-PURITY TUNGSTEN, JANUARY 1911 THROUGH FEBRUARY 1959. Earl T. Hayes and Ruth A. Pritchard (Bureau of Mines, Washington, D. C.). 1960. 46p.

The bibliography consists of 262 references to publications concerned with improving the purity of tungsten, from processing the ore to treating the finished metal. The period covered extends from January 1911 through February 1959. (B.O.G.)

23835 (BMI-1514(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING APRIL, 1961. Russell W. Dayton and Clyde R. Tipton, Jr. (Battelle Memorial Inst., Columbus, Ohio). May 1, 1961. Contract W-7405-eng-92. 84p.

Development studies are described for: reactor materials and components; alloy and ceramic fuels; gas-pressure bonding of fuel elements; uranium carbides; growth of UO_2 single crystals; radioisotope and radiation applications; uranium mononitrides; coated-particle fuels; recovery of spent fuel elements; fabrication processes for cold bonding Zircaloy-2 to Type 410 stainless steel; radiation effects on MGCR and SM-2 fuels; gas-cooled reactor program; corrosion of thorium and uranium under storage conditions; and gas-pressure bonding of beryllium-clad elements. (B.O.G.)

23836 (DMIC-Memo-114) REVIEW OF RECENT DEVELOPMENTS IN THE TECHNOLOGY OF MOLYBDENUM AND MOLYBDENUM-BASE ALLOYS. J. A. Houck (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). July 5, 1961. 5p.

A review is presented of recent developments in the metallurgy of molybdenum and molybdenum-base alloys. The information covers the period from April 1, 1960, to June 30, 1961. 8 references. (B.O.G.)

23837 (GEAP-3345) ECONOMIC COMPARISON OF CONTROL ROD MATERIALS. T. J. Pashos, G. D. Ritland, and H. E. Williamson (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Feb. 25, 1961. Contract AT(04-3)-189. Project Agreement No. 4. 24p.

Control rod materials and fabrication processes are compared for their relative economy. The examples apply specifically to the first Argonne National Laboratory Experimental Boiling Water Reactor core. The evaluation is based on the estimated cost of the control rods and their approximate nuclear lifetime. This study demonstrates a new method of comparing absorber materials. (auth)

23838 (IS-193) ANNUAL SUMMARY RESEARCH REPORT IN METALLURGY, JULY 1959–JUNE 1960. (Ames Lab., Ames, Iowa). Dec. 1960. Contract W-7405-eng-82. 119p.

Discussions are given of developments in the following areas: the preparation and purification of metals; phase equilibria and thermodynamic properties of alloys; physical and mechanical properties of metals and alloys; solid state studies; separation processes; and investigations dealing with diffusion, oxidation, and reduction, halide reactions, preparations, vapor pressure measurements, and transport reactions. (B.O.G.)

23839 (LM-TAB-16) LIQUID METALS TECHNOLOGY ABSTRACT BULLETIN, FOR PERIOD OF JULY, AUGUST AND SEPTEMBER, 1960. (MSA Research Corp., Callery, Penna.). 9p.

Eighteen abstracts from current material on liquid metals are presented. (P.C.H.)

23840 (NP-9485) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. M. J. Wahll, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Aug. 1960. 242p.

References (500) are given to current documents and journal articles in an abstracted form. The ASTIA serial number (AD) or OTS serial number (PB) is given for documents available for general distribution. Author, subject, and DMIC numerical indexes for the individual abstracts are also provided. (P.C.H.)

23841 (NP-10249) PRODUCTION DE ZIRCONIUM ALLIE PAR REDUCTION. (Production of Zirconium Alloys by Reduction). J. Gerard (Brussels. Centre d'Etude de l'Energie Nucleaire). Oct. 1959. 9p.

A sketch is given of little-used method for the production of zirconium or alloyed zirconium. This process consists in the thermocatalytic reduction of zirconium tetrafluoride by calcium in the presence of one or several other metals without the assistance of any thermal adjuvant and without subsequent fusion. Some peculiarities of the product inherent to the production procedure are defined. (tr-auth)

23842 (NP-10437) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Virginia L. Adams, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). July 1961. 57p.

References (92) are given to current documents and journal articles in an abstracted form. The ASTIA serial number (AD) or OTS serial number (PB) is given when possible for the reports available for general distribution. Author, subject, and DMIC numerical index are also provided. (P.C.H.)

23843 (NYO-4688) THE LINEAR ALPHA FUNCTION AND ITS APPLICATION TO BINARY ALLOY SYSTEMS. Wayne L. Worrell (Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy). [June 1961]. Contract AT(30-1)-1888. 12p.

The sub-regular solution model leads to an alpha function, $\alpha_i = RT \ln \gamma_i/(1 - N_i)^2$, which varies linearly with composition. The linear variation of α_i holds true for the solvent in the dilute composition range (0 to 0.20 mole fraction) of many liquid binary systems and, for some binary metal systems, holds over the entire composition range. The extension of α_i to binary alloy systems with miscibility gaps is discussed, and tables are given for estimating activities in such systems. (D.L.C.)

23844 (TID-3564) MOLTEN SALTS—SELECTED REFERENCES. William E. Bost, comp. (Office of Technical Information Extension, AEC). July 1961. 27p.

References (205) are included from unclassified U. S. and British reports, journals, and AEC translations from mid-1958. For convience in abstract scanning, NSA abstract numbers are provided, and availability and price information is given when known. (P.C.H.)

23845 (TID-4005(Pt.1, 6th Ed.)) SUMMARIES OF THE USAEC BASIC RESEARCH PROGRAMS IN METALLURGY, SOLID STATE PHYSICS AND CERAMICS. R. J. Allio, ed. (Division of Research, AEC). [1961]. 270p.

Brief summaries are presented of the scope of USAEC research programs in metallurgy, solid-state physics, and ceramics. (D.L.C.)

23846 (TID-7610(p.32-43)) IODINE ADSORPTION BY ACTIVATED CHARCOAL AT LOW PARTIAL PRESSURES. E. E. Anderson, G. L. Wessman, and L. R. Zumwalt (General Atomic Div., General Dynamics Corp., San Diego, Calif.).

Experiments were initiated to determine the parameters necessary for the adsorption of iodine by activated charcoal at temperatures from 0 to 400°C. The first method used to obtain adsorption isobars and isotherms was a dynamic system using helium gas to transport iodine vapor into a small heated charcoal bed. Data indicated that the logarithm of the specific adsorption is a linear function of the temperature in the range from 25 to 350°C. The second method involved the adsorption of iodine on charcoal in an evacuated static system where the iodine would presumably behave as a Knudsen gas at low vapor pressures. The data obtained by these two methods were in satisfactory agreement. Since iodine adsorption on activated charcoal was found to follow the Freundlich equation, evaluation of a particular charcoal can be made by experimentally determining two points at any temperature and pressure. (M.C.G.)

23847 (AEC-tr-4663) METHODS AND RESULTS OF MODERN SINGLE-CRYSTAL GROWTH. A. Neuhaus. Translated by C. B. Finch (Oak Ridge National Lab.) from Chem.-Ingr.-Tech., 28: 155-61(1956). 20p.

The theory of crystallization and growth of single crystals is treated, and the effects of saturation, supersaturation, metastable states, linear growth velocity, and spontaneous nucleation are discussed. Some experimental data on crystal growth are reported, and methods of crystallization are discussed. (D.L.C.)

23848 (JPRS-4716) A NEW METHOD OF ZONE MELTING FOR REFINING SUPER-PURITY GALLIUM. Min-chih Liu. Translated from Wu Li Hsueh Pao, 15: 389-92(July 1959). 7p.

A method for refining Ga to super purity levels (99.9999%) is described which uses a helix zone-melting apparatus. The helix, made out of plastic tubing, is filled with Ga and rotated near heaters to set up zone melting. (D.L.C.)

23849 (NP-tr-644) HANDBOOK OF MACHINE BUILDING MATERIALS. G. I. Pogodina-Alekseev (Pogodina-Alekseyev). Translated from p.678-769, Vol. 1 of "Spravochnik po Mashinostroitel'nym Materialam," 1959. 190p.

Discussions are given of the applications, compositions, and properties of acid-resisting, high-temperature oxidation-resistant, and heat-resisting alloy steels containing chromium, nickel, manganese, molybdenum, niobium, and titanium, and non-ferrous alloys of these metals. (B.O.G.)

23850 (NP-tr-664) CONCERNING THE PROBLEM INVOLVED IN THE EQUIVALENCE OF EFFECT EXERTED BY THE RATE AND TEMPERATURE OF DEFORMATION ON THE PLASTIC DEFORMATION PROCESS. L. E. (Ye.) Popov. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 3, 91-9(1958). 17p.

Results of a comparative study concerning the effect of the rate and temperature of deformation on the mechanical properties and microstructure of polycrystalline Ni at 356 to 467°C are presented. The flow curves were found to remain constant within this range of temperatures, if the rate and temperature of deformation is varied so as to insure a continuous satisfaction of the condition: $(\nu_2/\nu_1) = (e^{U/RT_1}/e^{U/RT_2})$, where U stands for the activation energy of self-diffusion. The statistical study of the microstructure of deformed specimens demonstrated that the contribution of various deformation mechanisms to the total deformation is determined by flow stresses, and does not depend, at the given flow curve, on the rate and temperature of deformation. (auth)

23851 (NP-tr-668) THE PRODUCTION OF REACTOR-GRADE GRAPHITE. Y. Saito. Translated by S. G. Brickley (U.K.A.E.A. Atomic Energy Research Establishment) from Tanso (Carbons), 7: No. 1, 16-19(1958). 12p.

Research and development on reactor-grade graphite is reported. Specimens with a density of 1.72 which were considered suitable for reactor use were obtained. Other samples were produced which were satisfactory for reflector and moderator use. (J.R.D.)

23852 THE PREPARATION OF THORIUM OXIDE MICROSPHERES. I. ON THE PREPARATION OF SPHERICAL THORIUM HYDROXIDE PARTICLES. Yasaburo Yamazaki, Kenzo Yoshida, and Matsuo Komori (Japan Atomic Energy Research Inst., Tokyo). J. At. Energy Soc. Japan, 3: 360-4(May 1961). (In Japanese)

Thorium hydroxide slurry containing a small extent of thorium nitrate became a yellow sol when heated for several hours. Spherical thorium hydroxides made by spraying this sol through a nozzle into certain organic solvents were heated higher than 260°C to get spherical oxides. Several experiments were performed to find the optimum conditions and the mechanism of the formation of the microspheres. Isopropyl alcohol was the best solvent and the mixture of ethyl alcohol and isobutyl alcohol (2 : 3) also effective. The preferable sol to solvent ratio was about 1 : 10. It was necessary that the sol concentration be greater than 1.5 m and the water content in the alcohol smaller than 10%. Controlling the spray speed of the sol made possible production of spherical particles up to 50 or 60 μ in diameter. (auth)

23853 URANIUM DIOXIDE SINGLE CRYSTALS BY ELECTRODEPOSITION. R. G. Robins (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 3: 294-301(Mar.-Apr. 1961). (In English)

Separate single crystals of uranium dioxide were obtained by the electrolysis of uranyl chloride in fused alkali metal

chloride melts, at potentials below the apparent decomposition potential for the reaction $UO_2Cl_2 \rightarrow UO_2 + Cl_2$, and at low cathode current density. Electrolysis was carried out using a platinum cathode and a carbon anode. Uranium dioxide crystals of cubo-octahedral habit were grown on the cathode to a size of about 3 mm across and a mass of about 50 mg. A side reaction was observed which could be controlled to result in crystals at the cathode having compositions approximating to UO_2, U_4O_9, or U_3O_8. (auth)

23854 EXPERIENCE WITH VIBRATORY POLISHERS AND DESIGN FOR HOT-CELL APPLICATION. E. L. Long, Jr., J. T. Meador, and R. J. Gray (Oak Ridge National Lab., Tenn.). p.79-89 of "Symposium on Methods of Metallographic Specimen Preparation (1960). Special Technical Publication No. 285." Philadelphia, American Society for Testing Materials, 1960.

Vibratory polishers have been in use in the Metallography Department of the Metallurgy Division of Oak Ridge National Laboratory (ORNL) for approximately four years. During this period, vibratory polishing changed from a complementary tool for standard metallographic techniques to the prime method of specimen preparation. An estimated 90 per cent of all specimens are now prepared through vibratory polishing in this department. Plans were made for adaptation to remote operation, based on past experience with the vibratory polishers in the "cold" laboratory and several features unique to the polishers. Several necessary design changes were made which in turn had to be compensated in the vibratory system to maintain proper polishing action. To complement the remoted polishers a new specimen holder was designed which allows easy insertion and removal of the specimens using master slave type manipulators. (auth)

23855 AVAILABILITY OF GRAPHITE FOR REACTOR USE ESPECIALLY FOR THE CANNING OF FUEL ELEMENTS. K. W. F. Etzel and E. Fitzer (Siemens-Planiawerke A. G., Meitingen, Ger. and Farbwerke Hoechst A. G., Frankfurt am Main). p.237-45 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

The graphite-types for nuclear purposes available at present in the German Federal Republic are described; their physical data and the deviation-ranges of the latter are disclosed. In particular the artificial graphite-types Sigri AMT, AMC, and ARS will be described, as well as the fine-grain types Sigri E and N, both of the latter being especially suitable to serve as starting-materials for subsequent sealing processes. Furthermore, special graphites with high bulk density, extreme impermeability for gases and extreme strength are discussed, which are partly still under development. (auth)

23856 PLASTICS IN NUCLEAR ENGINEERING. James O. Turner. Reinhold Plastics Applications Series. New York, Reinhold Publishing Corporation, 1961. 146p. $5.50.

A thorough discussion of a number of plastics applications that are of value in the nuclear field, and of the effect of radiation on plastics is presented. The material is of value to the engineer who has the responsibility of designing bevatrons, reactors, bubble chambers, and perhapsatrons, and making them work. The book contains no history, no chemistry, and no mathematics. (N.W.R.)

23857 POWDER METALLURGY. Werner Leszynski, ed. Proceedings of an International Conference held in New York, June 13-17, 1960, under the joint sponsorship of the Metal Powder Industries Federation and the Powder Metallurgy Committee of the Institute of Metals Division, The Metallurgical Society, American Institute of Mining, Metallurgical, and Petroleum Engineers. New York, Interscience Publishers, 1961. 858p. $25.00

Ten of the thirty-six papers in these Proceedings are abstracted separately. One was abstracted previously. Powder metallurgy is discussed with reference to sintering, dispersion strengthening, technology and methods, theory, and materials and applications. (N.W.R.)

23858 THE ROLE OF POWDER METALLURGY IN DISPERSION-STRENGTHENED ALLOY DEVELOPMENT. C. G. Goetzel and R. F. Bunshah (New York Univ., New York). p.253-66 of "Powder Metallurgy." Werner Leszynski, ed. New York, Academic Press, 1961.

Alloys signified by a dispersed second phase in a metallic matrix tend to retain their strength at elevated temperatures longer and nearer the melting point than other types. The most versatile technique consists of mechanically mixing fine powders of the matrix metal and a nonmetallic substance. Matrix metals encompass copper, nickel, tungsten, molybdenum, stainless steel, and many others. The most effective dispersoids belong to the group of refractory oxides including alumina, thoria, titania, and zirconia, but certain carbides and borides may also lead to interesting results. The other techniques consist of precipitation from the liquid during solidification or are based on chemical reactions, such as co-precipitation followed by reduction of one component, reaction with oxygen on either the surfaces or interior of powder particles. Copper-alumina and copper-silica, or nickel-alumina are important examples of this internal oxidation process. While an improved dispersion and smaller dispersoid size tend toward better physical properties, fewer alloy systems are suitable for dispersoid formation by chemical reaction than by mixing the powdered ingredients. (auth)

23859 ZIRCONIUM. OTS Selective Bibliography. Supplement to CTR-344. (Office of Technical Services, Washington, D. C.). May 1961. 17p. (SB-464)

Approximately 361 references of reports and foreign translations published during 1936-1961 are included. A separate list of 44 government-owned patents on zirconium is also included. (P.C.H.)

23860 RADIATION SHIELDS. Rudolf Rasch. British Patent 870,106. June 14, 1961.

A radiation shield is described. The shield is composed of 80 to 95% by weight ferro-silicon, in the so-called granular iron form, in cement. The particle size of the ferro-silicon material is broken down for the make-up of the shielding material. (N.W.R.)

23861 MATERIAL ABSORBING IONISING RADIATIONS. Mario Girolimetto. British Patent 871,521. June 28, 1961.

A material for the formation of screens substantially opaque to ionizing radiations such as x rays is described. The material consists of a thermoplastic or thermosetting polymer resin incorporating at least 5% by weight of mercuric iodide and at least 5% of the iodide of an alkali metal of Group I of the Periodic Table. The two iodides produce a double salt $3HgI_2 \cdot 2XI$ (where X represents the alkali metal). The resin is polymethyl methacrylate and is transparent to light in the molded form. The composition of the material may include the usual plasticizers and accelerators. (N.W.R.)

23862 ARC FURNACE FOR MELTING REACTIVE REFRACTORY METALS. Richard John Fletcher. British Patent 871,715. June 28, 1961.

A description is given of a method for melting reactive refractory metals and of the furnace used for the process. The process consists in feeding, in a liquid, powdered, gaseous, vaporous, or flowing thermolabile condition, a compound of a metal that can be vaporized and/or decomposed by heat through the bore of a cooled hollow electrode into the arc formed in an electric arc furnace operating under a vacuum or low pressure or in the presence of an inert gas under pressure. The compound is gasified or vaporized and/or chemically decomposed, leaving the metal in a molten pool, the gaseous product being continuously removed from the furnace. The arc furnace consists of a furnace chamber, a nonconsumable liquid-cooled hollow electrode having a bore suited to the introduction of the thermolabile metal compound, a liquid-cooled crucible or mold in which the molten metal is received, and a circulating pumping system for creating a vacuum or low pressure within the furnace chamber and for extracting the products of decomposition. High purity molten titanium, zirconium, nickel, beryllium, molybdenum, tungsten, silicon, and germanium are obtained by this method. (N.W.R.)

Corrosion

23863 (CF-60-4-111) A GALVANIC CORROSION PROBLEM ASSOCIATED WITH THE PREPARATION OF MULTIMETALLIC BERYLLIUM SAMPLES. D. M. Hewette, II (Oak Ridge National Lab., Tenn.). Apr. 20, 1960. 9p.

Artifacts were noticed in the microstructure of multimetallic beryllium samples that were polished on the Syntron vibratory polisher. The artifacts were at first erroneously attributed to diffusion of beryllium into the dissimilar metal. The real cause of the effect is thought to be caused by a galvanic corrosion which takes place during polishing. Small additions of sodium nitrate to the polishing slurry were found to eliminate the corrosion. (auth)

23864 (NP-10393) STRESS CORROSION CRACKING. Technical Report No. 3. D. van Rooyen (Westinghouse Electric Corp. Research Labs., Pittsburgh). Aug. 25, 1960. Contract Nonr-2868(00). 46p.

The addition of small amounts of nitrogen, or larger amounts of molybdenum, reduces the resistance of austenitic stainless steels to transgranular stress corrosion cracking. Increasing the carbon or nickel contents, and perhaps tin to some extent, makes the alloys more resistant to cracking. These variations in time to failure result from differences in the reaction time preceding crack propagation, while the rate of crack penetration remains approximately constant. Composite stress corrosion samples were made in which the test alloys were bonded to a steel which was susceptible to cracking. Results showed that there is good correlation between the times to failure of the experimental alloys when tested alone and the number of propagating cracks which will penetrate into them. The possibility is suggested that crack initiation consists of a form of corrosion attack which is required to expose a path of rapid corrosion, after which true cracking proceeds. Potential measurements indicate that strain-induced anodic depolarization cannot account for cracking entirely by an electrochemical mechanism. Preference is given to an electrochemical mechanism wherein reaction takes place at sites of structural and composition changes in the steels. These may be formed under the influence of stress, setting up paths of easy localized corrosion. (auth)

23865 (ORNL-3151) THE CORROSION OF ALUMINUM ALLOYS IN THE OAK RIDGE RESEARCH REACTOR. P. D. Neumann (Oak Ridge National Lab., Tenn.). July 7, 1961. Contract W-7405-eng-26. 26p.

A corrosion testing program designed to estimate the potential service life of aluminum alloys used in the construction of the Oak Ridge Research Reactor (ORR) cooling systems has been in progress for over two years. The five alloys (1100, 3003, 5052, 5154, and 6061) used to the greatest extent in the reactor exhibited continuously decreasing corrosion rates since the first 500-hr inspection. Samples exposed in the core-cooling loop have shown a decrease in corrosion rate from a 2.6 mpy maximum for one group during the first 500 hr to an over-all average of less than 0.1 mpy for another group after a full year in test, with the maximum metal loss less than 0.1 mils. Results indicate that with suitable water treatment the aluminum alloys used in the ORR may be expected to give satisfactory performance for many years. Based on the generalized corrosion rates alone, 40 to 50 years of service life may be expected. However, since occasional localized corrosion has been observed (rarely), minor repairs will almost certainly be required before that time. (auth)

23866 (TID-11037) CORROSION RESEARCH WITH FIELD AND ION MICROSCOPY. Final Report. Robert Gomer (Chicago, Univ. Inst. for the Study of Metals). [1960]. 37p. Contract AT(11-1)-604.

A method for obtaining field emission from whiskers grown in situ from vapor under high vacuum conditions is described. Electrical methods for following the growth kinetics and determining whisker length and radii are described and applied to Au. Growth is positively exponential with time, and cessation of growth was found to be diffusion limited. Absorption and oxidation experiments indicate that the method can also be used to study these phenomena. (J.R.D.)

23867 ON CORROSION UNDER STRESS. A. Bassi, E. Brutto, G. Imarisio, G. Perona, and R. Sesini (Laboratori CISE, Segrate, Italy). Energia nucleare (Milan), 8: 361-3(May 1961). (In Italian)

Photomicrographs are shown of 304 stainless steel samples after chloride stress corrosion tests at temperatures to 900°C. (D.E.B.)

23868 DYNAMIC CORROSION TESTING WITH WATER AND STEAM. F. Müller (Sulzer Bros., Winterthur, Switzerland). Nuclear Power, 6: No. 61, 68-70(May 1961).

Designs are presented for steam and water circuits for the dynamic corrosion testing of reactor materials such as zirconium or Zircaloy-2 (particularly with respect to the embrittlement of zirconium after absorption of hydrogen). The pump and autoclave designs used are also presented. (N.W.R.)

Fabrication

23869 (AD-249233) THE MANUFACTURE OF Ti–7Al–12Zr SHEETS. Bi-Monthly Report No. 7, August 21–October 30, 1960. J. K. Dietzel, S. R. Seagle, and O. Bertea (Reactive Metals, Inc., Niles, Ohio). Nov. 1960. Contract NOa(s) 59-6229-c. 8p.

A study of cleaning methods for production rolled 0.040-in. sheet was continued. An additional 0.002-in. was picked from hot rolled and descaled sheet making the total amount of removal, prior to vacuum annealing, 0.009 in. Laboratory tensile tests conducted on this material showed that the ductility of stabilized sheet continued to increase with the amount of metal removed. A 0.410-in. plate was rolled in production to one 0.125-in. sheet. This sheet is presently being evaluated. Preliminary preparations were made for production rolling of the remaining 4000 pounds of slab to the specified gages. A laboratory program for rolling 0.020-in. sheet was initiated. (auth)

23870 (AMC-TR-7-782(IV)) THE DEVELOPMENT OF OPTIMUM MANUFACTURING METHODS FOR COLUMBIUM ALLOY FORGINGS. Interim Technical Engineering Report, December 15, 1960–March 15, 1961. R. O. Carson (Crucible Steel Co. of America. Midland Research Lab., Penna.). Mar. 1961. Contract AF33(600)-39944. 53p.

Good quality four-inch-diameter ingots of four Nb-base alloys were made by double vacuum-arc melting of normal purity Nb powder for F48(Nb–15W–5Mo–1Zr), double vacuum-arc melting of high-purity Nb powder for D31 (Nb–10Ti–10Mo) and D41 (Nb–10Ti–6Mo–20W) and electron-beam melting followed by vacuum-arc remelting for Cb74 (Nb–10W–5Zr). (auth)

23871 (AMC-TR-7-784(IV)) THE DEVELOPMENT OF OPTIMUM MANUFACTURING METHODS FOR COLUMBIUM ALLOY SHEET. Interim Technical Engineering Progress Report, December 15, 1960–March 15, 1961. R. O. Carson and J. B. Guernsey (Crucible Steel Co. of America. Midland Research Lab., Penna.). Mar. 1961. Contract AF 33(600)-39942. 50p.

Two consolidation techniques—electron-beam melting plus vacuum-arc remelting of nominal purity niobium and double vacuum-arc remelting of high-purity niobium—were evaluated and compared for making the Nb–10Mo–10Ti alloy, D31. The electron-beam plus vacuum-arc remelt of normal-purity niobium was selected as the preferred consolidation technique since it produced the better quality ingot at a lower cost and avoids a difficult electrode preparation schedule. (auth)

23872 (ANL-6168) THE ZrO_2–CaO–UO_2 CERAMIC FUEL FABRICATION FOR THE EBWR SPIKED CORE ELEMENTS. Final Report–Metallurgy Program 7.9.5. R. C. Lied, E. D. Lynch, and J. H. Handwerk (Argonne National Lab., Ill.). May 1961. Contract W-31-109-eng-38. 17p.

A series of experiments was proposed in which the thermal output of the EBWR is increased to 100 Mw. The increase in thermal energy will be accomplished by inserting 32 spike elements in the initial fuel core. The fuel selected for the spike elements was a cubic solid solution in the system ZrO_2–CaO–UO_2. The ceramic fuel was fabricated in the form of pellets by compacting a mixture of U_3O_8, $CaCO_3$, and ZrO_2. The pressed pellets were sintered in air at 1675°C ± 25°C to form a cubic solid solution having a composition of 9.01 wt.% UO_2 (93% enriched), 9.07 wt.% CaO, and 81.92 wt.% ZrO_2. The procedures used in forming the fuel pellets are described. Following fabrication, the pellets were loosely inserted into Zircaloy-2 tubes for subsequent assembly into fuel elements. (auth)

23873 (DMIC-Memo-70) HIGH-VELOCITY METAL PROCESSES BASED ON THE SUDDEN RELEASE OF ELECTRICAL ENERGY. H. J. Wagner and F. W. Boulger (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Oct. 27, 1960. 17p. (PB-161220)

Metal forming processes are discussed in which the energy applied to the workpiece originates as electrical energy stored in high-voltage capacitors. In these methods current or magnetic fields are used to create shock waves. (J.R.D.)

23874 (DMIC-Memo-74) JOINING OF TUNGSTEN. R. E. Monroe (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Nov. 24, 1960. 10p. (PB-161224)

A review of existing information on joining W is presented which includes a list of methods, metallurgical effects which have a bearing on joining, and applications being investigated to provide additional background on this technology. (J.R.D.)

23875 (NP-10337) THE EFFECT OF ARC PLASMA DEPOSITION ON THE STABILITY OF NON-METALLIC MATERIALS. Final Report Covering Period April 1960–May 1961. B. E. Kramer, M. A. Levinstein, and J. W. Grenier (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). 61p. Contract No. Noas-60-6076-C.

The oxides of Al, Cr, Zr, Ce, Hf, and mixtures of Zr and Nb, the carbides of Hf, Ta, and Zr, the nitrides of Ti and Ta, and the boride of Zr can be sprayed on a graphite substrate without chemical or microstructure alteration. The operating conditions for the deposition of these materials have been determined. Physical properties were obtained which are useful in design data including the coefficient of thermal expansion, density, compressive strengths, electrical resistance and hardness. The resistance of the deposited coatings to a 5000°F, high velocity, air blast was determined as well as the static oxidation behavior. Alumina, chromia and zirconium boride can be deposited readily in thick, dense serviceable deposits. These materials conferred resistance to a graphite substrate in the blast test, zirconium boride through the smooth conversion to a dense adherent zirconia coating. The carbides and nitrides produced poorer thinner deposits which did not withstand the oxidation erosion test. Ceria and hafnia were not satisfactorily deposited; zirconia as laid down from the oxide powder yields a highly stressed deposit. (auth)

23876 (NP-10346) DEVELOPMENT OF TECHNIQUES FOR PRODUCING BERYLLIUM STRUCTURAL SHAPES. Third Interim Technical Report [for] Period January 29, 1961 to April 28, 1961. Final Phase II Report. K. C. Taber and E. E. Weismantel (Beryllium Corp., Reading, Penna.). Contract AF 33(600)-41959. 83p.

The effects of beryllium oxide level and mill rolling history on the properties of rolled sheet and bar were studied. The studies concluded that the low beryllium oxide product was presently preferred for the development of high strength structural materials because of a better statistical property consistency. In contrast, the higher beryllium oxide material, possessing 5 to 10% higher ultimate tensile strength at room temperature, had greater deviation in both tensile properties and formability than the lower beryllium oxide material. The testing performed to date has indicated that the ultimate tensile and yield strength objectives will be obtainable using the low beryllium oxide material. Although the flat rolled products only approximated the minimum properties to be attained by the end of the program, the testing of roll-reduced bar resulted in tensile properties as high as 103,800 psi ultimate tensile strength, 74,800 psi yield strength, and 6% elongation. Supporting efforts were expended during this phase to evaluate processing variables such as specimen preparation, thermal treatments, surface preparation, and the like to determine the effect on mechanical properties. (auth)

23877 (ORO-443) SYNTHESIS AND FABRICATION OF REFRACTORY URANIUM COMPOUNDS. Monthly Progress Report No. 2, April 1 through April 30, 1961. K. M. Taylor and C. H. McMurtry (Carborundum Co. Research and Development Div., Niagara Falls, N. Y.). May 16, 1961. Contract AT-(40-1)-2558. 4p.

Powder synthesis experiments, in which stoichiometric mixtures of UO_2 and C were reacted to form UC in a vacuum induction furnace, are summarized. Preliminary sintering experiments in He were carried out on UC, UC +

10% UH_3, UC + 0.1% Fe, and UC + 1% Fe compositions, and the resulting sintered densities given. (D.L.C.)

23878 (TID-3563) EXTRUSION OF URANIUM, URANIUM ALLOYS, AND URANIUM COMPACTS. A Literature Search. Theodore F. Davis, Comp. (Office of Technical Information Extension, AEC). June 1961. 33p.

A bibliography of 240 references is presented on the extrusion of U, U alloys, and U compacts. The references were taken from Nuclear Science Abstracts and cover the period Jan. 1951 to June 1961. (D.L.C.)

23879 (TID-6993) PROGRESS REPORT NO. 9 ON ANNEALING OF COLD WORKED METALS. Paul A. Beck, B. G. Ricketts, M. N. Parthasarathi, P. P. Sinha, R. Diesner, and J. J. Gautier (Illinois. Univ., Urbana). October 1, 1960. 60p. Contract AT(11-1)-67, Project No. 9.

The relative intensities of the various Al recrystallization texture components can be accounted for in terms of differences in boundary mobility between twist and tilt boundaries, and between the various tilt boundaries having different orientations but separating recrystallized grains and matrix which have a fixed orientation relationship to each other. A full account of this work is reported in an attached paper which has been submitted for publication along with another paper on Zn. Other work not described in the papers was directed toward a similar study with a commercial Al crystal of the (110) $(\bar{1}\bar{1}2)$ orientation. Results of investigations show a sharp recrystallization development by selective growth of random nuclei in an 80%-rolled high purity Al crystal of initial orientation (123) $(4\bar{1}2)$. All components of the recrystallization texture were related to the deformation texture by 40° rotations around [111] axes. It was concluded that all known recrystallization textures in polycrystalline Al as well as single crystals, may be qualitatively accounted for on the oriented growth mechanism. No oriented nucleation mechanism was suggested that could satisfactorily account for any recrystallization in Al. In work on Cu, the (220) pole figure was determined for OFHC Cu rolled to 96% RA. The texture was found to consist of 8 components of 3 types roughly described by the orientations (135) $[\bar{2}\bar{1}1]$, (112) $[11\bar{1}]$ and (110) $[1\bar{1}2]$ and very extensive orientation spreads. The volume fraction of the specimen corresponding to the four components of the type of orientation near (135) $[\bar{2}\bar{1}1]$ is larger than the volume fraction of the other two types of orientation combined. (J.R.D.)

23880 (NP-tr-624) SOLDERING OF METALS (SELECTED ARTICLES). N. F. Lashko and S. V. Lashko-Avakyan. Translated from pages 344-57; 381-93; 421-4 of "Payka Metallov," Moscow, 1959. 58p.

Six selected articles on soldering of metals are presented. Soldering and brazing stainless steels, tool steels and hard alloys, Mo, W, Ti, Zr, Ta, and Be are discussed. Separate abstracts were prepared for three of the papers. (M.C.G.)

23881 (NP-tr-624(p.29-34)) BRAZING AND SOLDERING OF MOLYBDENUM AND TUNGSTEN. (Translation).

The quality of molybdenum brazing was found to depend on the fact that the metal is easily oxidized and that it becomes brittle after heating to high temperatures. The strength and plasticity of molybdenum depended on its oxygen content. The best method of brazing molybdenum was found to be by induction heating in an argon or hydrogen atmosphere. Copper alloys gave best results in brazing molybdenum. Brazing of tungsten and molybdenum with copper was carried out in a hydrogen medium at a temperature of 1150°C. Experiments showed that tungsten could be soldered with copper by using a low-melting solder with a fluoride flux. Tungsten was soldered with low-melting tin by first giving it a galvanized coating of copper. (M.C.G.)

23882 (NP-tr-624(p.35-49)) THE SOLDERING AND BRAZING OF TITANIUM, ZIRCONIUM, TANTALUM, AND THEIR ALLOYS. (Translation).

Difficulties in soldering and brazing titanium and zirconium arose from their tendency to oxidize and to form nitrides with nitrogen in air. These metals were also inclined to absorb hydrogen, causing them to become brittle. It was found that formation of the oxide layer on titanium during heating could be avoided by the use of special fluxes, by quickly heating the components to the brazing temperature and then completing the brazing in a vacuum or in an atmosphere of inert gases, or by first tinning the parts to be brazed in the absence of air. The fluxes recommended for brazing titanium and its alloys contained mostly metallic chlorides and fluorides. The titanium joints brazed in pure inert gases, as a rule, were stronger than those brazed under flux. The most promising solder for titanium and zirconium was silver. A pre-coating of tin allowed titanium and its alloys to be brazed with steel, copper, and aluminum. A study was made on the resistance to corrosion of soldered seams of Zircaloy-2. Because of its properties, the brazing of tantalum was very similar to the brazing of titanium. (M.C.G.)

23883 (NP-tr-624(p.50-7)) SOLDERING OF BERYLLIUM. (Translation).

The basic difficulty encountered in soldering beryllium was the elimination of the oxide which formed on the metal surface. The preparation of beryllium by tinning is discussed. Best results in soldering were obtained with such solders as silver or silver-copper eutectic in a vacuum or an inert medium. Beryllium was subjected to weld-soldering with the help of aluminum and its alloys. (M.C.G.)

23884 (NP-tr-645) FUNDAMENTALS OF STEEL ALLOYING (Selected Parts). (Osnovy Legirovaniya Stali). V. S. Mes'kin. Translated from a publication of the Publishing House of Metallurgizdat, Moscow, 1959. 247p.

Discussions are given of the effects of alloying on the weldability of steels, and the characteristics and effects of alloying materials on heat-resistant, thermally-stable, acid-resistant stainless steels. (B.O.G.)

23885 (NP-tr-653) REASONS FOR FORMATION OF CRACKS IN WELDED JOINTS OF HIGH PRESSURE PIPELINES AND MEANS OF AVOIDING THEM. S. S. Yakobson. Army Research and Development Labs. Translation T-112. 11p.

The results of studies on the formation of cracks in welded joints of high-pressure pipelines are summarized. The cracks formed more often in the process of welding the first foundation weld. They were intercrystalline in nature, and almost always had the same nature of propagation. The main reason for the formation of cracks was the presence at the joint of the steel packing ring. A considerable effect on crack formation was also exerted by the excessive rigidity of the joint. Methods that can be used to avoid almost completely the origination of cracks in the root of the weld are outlined. Research into the development of an efficient joint construction and welding technique without residual packing rings is described. (M.C.G.)

23886 (NP-tr-670) WELDING OF TECHNICAL MOLYBDENUM IN AN INERT ATMOSPHERE. N. A. Ol'shanskii (Ol'shanskiy) and A. V. Mordvintseva. Translated from Avtomat. Svarka, No. 10(91), 36-41(1960). 9p.

Investigations were made of the welding of sintered and

cast molybdenum in an inert atmosphere of argon. In all the samples of sintered molybdenum that was welded, cracks originated along the axis of the seam. Tantalum and titanium were tested in the role of deoxidizers to obtain crackless seams. When tantalum was used there were no cracks along the seam but pores were observed on the surface. When titanium was used the seams had a fine outer appearance without cracks and pores but the plasticity of the welded joints was very low and the seams were destroyed during bending. Welding of cast molybdenum was realized without modifiers and the seams obtained had no cracks. The plasticity of the base metal and welded seams at room temperature was improved by brief heating with an electron beam. Pickling the surface of the base metal and burnishing the seam surface also improved the plasticity of the seam. (M.C.G.)

23887 (NP-tr-671) CASTING PROPERTIES AND SELECTION OF POURING METHOD FOR SCAB FORMING FUSIONS OF THE ZHS TYPE. I. M. Khafuz. Translated from p.41-6 of "Trudy Mezhvuzovskoy Nauchno-Tekhnicheskoy Konferentsii" (A publication of the State Scientific-Technical Publishing House of Machine Construction Literature, Moscow-Leningrad, 1960). 9p.

Information is presented concerning the properties, particularly those related to casting, of heat-resisting alloys. Casting qualities such as fluidity, shrinkage, and crack formation tendencies are discussed along with pouring methods. The necessity of casting production with no oxide scab is noted and vacuum experiments in this area are mentioned. (J.R.D.)

23888 MANUFACTURE OF FUEL PLATES FOR RESEARCH REACTORS BY THE COEXTRUSION TECHNIQUE. K. Ennerst, K. G. Hackstein, and H. J. Hein (NUKEM Nuklear-Chemie und -Metallurgie G.m.b.H., Wolfgang, bei Hanau, Ger.). Atomwirtschaft, 6: 325-32(June 1961). (In German)

The coextrusion process for the manufacture of fuel plates for Argonaut reactors is treated in terms of the fuel elements made for the Siemens-Argonaut reactor. Aluminum is used as material for the cladding and thinning of enriched U_3O_8, the fuel material is formed directly with the coating material to a finished profiled band. Manufacturing technique, material questions and the working up of the extruded bands into fuel plates are extensively described with technical data. (auth)

23889 PROCESS VARIABLES IN PLASMA-JET SPRAYING. D. R. Mash, N. E. Weare, and D. L. Walker (Advanced Tech. Labs., Mountain View, Calif.). J. Metals, 13: 473-8 (July 1961).

Results of current plasma-jet spraying investigations show the effects of numerous process variables on deposition efficiency and coating density. Variables which can greatly influence efficiency include: power input, arc-gas flow, and spray distance. Moderate effects result from varying the powder feed rate and powder gas flow rates within reasonable limits. Changes in traverse rate have little or no effect on deposition efficiency and density. Using the SG-1 spraying system, conditions were established which produced the best deposition efficiencies within the limitations of the equipment. These conditions for the spraying of selected materials are listed. (auth)

23890 PLASMA SPRAYING TECHNIQUES FOR TOXIC AND OXIDIZABLE MATERIALS. A. R. Stetson and C. A. Hauck (Solar Aircraft Co., San Diego, Calif.). J. Metals, 13: 479-82(July 1961).

Facilities can be built to control both the toxicity and oxidation problems associated with the plasma spraying of beryllium, beryllium oxide, and various carbides and a nitride. With high quality powders, deposits can be obtained that are at least 90% dense, and which are strongly adherent and have high impact resistance. Properties and spraying characteristics are given for the sprayed materials. Possible uses are as coatings on rocket nozzles, jetavators, and reentry nose cones of ballistic missile and aerospace gliders. Plasma spraying also provides a means of fabricating structure of single or composite materials that would be nearly impossible to fabricate by other means. (auth)

23891 THE SINTERING CHARACTERISTICS OF BeO. E. A. Aitken (General Electric Research Lab., Schenectady, N. Y.). J. Nuclear Materials, 3: 302-10(Mar.-Apr. 1961). (In English)

The effects of various parameters on the sintering characteristics of beryllium oxide are described. The presence of water vapor in the sintering atmosphere is found to retard the densification of beryllium oxide compacts. The sinterability can be improved if the compacts are predried at 900°C in air and sintered in a dry atmosphere. The effect of water vapor on the sintering rate is largely eliminated if 0.25 mole per cent MgO is added to the BeO compact. Beryllium oxide powder calcined at 1250°C instead of 900°C has a slower sintering rate but appears to be capable of achieving similar ultimate densities at longer sintering times or higher temperatures. The presence of 0.25 mole per cent of $AlO_{1.5}$, $CrO_{1.5}$, MgO, and NiO, increases the ultimate density of BeO compacts relative to compacts without additive. MgO and $AlO_{1.5}$ are particularly effective at increasing the density. (auth)

23892 THE CONNECTION OF ZIRCALOY-2 WITH STAINLESS STEEL FOR OPERATION OVER A WIDE TEMPERATURE RANGE. C. Gordon Duff (Canadian Westinghouse Company, Ltd., Hamilton, Ont.). Nuclear Sci. and Eng., 10: 278-84(July 1961).

A method for joining Zircaloy-2 with stainless steel, using controlled expansion transition sections, is described. The transition sections consist of nickel-iron elements of the Invar type and range from low expansion rate 43% nickel-iron, at the Zircaloy-2 end to high expansion rate 60% nickel-iron at the stainless steel end. Problems encountered in producing suitable mechanical joints between Zircaloy-2 and 43% nickel-iron and in preparing and welding the various grades of nickel-iron to each other and to stainless steel are discussed. (auth)

23893 USE OF INCONEL DEPOSITED WELD METAL FOR NUCLEAR COMPONENT PARTS. R. W. Minga and W. H. Richardson (Combustion Engineering, Inc., Chattanooga, Tenn.). Welding J.(N. Y.), 40: 726-35(July 1961).

A summary is presented of the problems encountered in welding Inconel for nuclear power plant components to satisfy quality requirements, principally with the gas tungsten-arc process and the gas metal-arc process. Concurrently with developments in welding Inconel with the inert gas processes, extensive use is made of the covered electrode processes, and development work in submerged arc welding is conducted. Problems relating to these latter processes are briefly described. (N.W.R.)

23894 DEVELOPMENT, DESIGN, AND PRODUCTION OF PLASTIC-IMPREGNATED PAPER HONEYCOMB TO FIT CURVED SURFACES. R. W. Weaver (Sandia Corp., Livermore, Calif.). p.1-12 of Section 3-D of "Proceedings of the 16th Annual Meeting of the Reinforced Plastics Division of the Society of the Plastics Industry, February 1961. (SCR-304)

Honeycomb cores with specially designed cell shapes can be expanded, without anticlastic distortion, over cylinders, hemispheres, and complexly curved surfaces. When impregnated with plastic, these honeycombs form load-bearing structures of low density and high strength. Some manufacturing techniques for such honeycombs are in an advanced stage of development. Feasibility studies and development work are in progress for a number of new cell configurations and manufacturing processes. (auth)

23895 FUEL ELEMENT FABRICATION WITH SPECIAL EMPHASIS ON CLADDING MATERIALS. VOLUME 1. Proceedings of a Symposium held in Vienna, May 10-13, 1960. London and New York, Academic Press, 1961. 545p. £5-$14.00.

The first part of this volume is devoted to treating the characteristics of cladding materials (zirconium and zirconium alloys, graphite, etc.). Part II deals with various aspects of fuel element fabrication. Twenty-eight papers are included; separate abstracts have been prepared for 27. One paper was previously abstracted in NSA. (N.W.R.)

23896 ZIRCONIUM ALLOYS FOR WATER-COOLED POWER REACTORS. W. R. Thomas (Atomic Energy of Canada Ltd., Chalk River, Ont.). p. 3-18 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

The Canadian power reactors, NPD (Nuclear Power Demonstration) and CANDU (Canadian Deuterium Uranium) will both use zirconium alloys for fuel sheathing and pressure tubes. Two major difficulties with these alloys in such reactors are radiation embrittlement and hydrogen pick-up during corrosion. A study of the effects of hydride precipitate on the mechanical properties of Zircaloy-2 indicates that concentrations considerably in excess of the solid solubility limit at operating temperature may be acceptable. Thermal diffusion of hydrogen in zirconium is investigated and the heat of transport determined. A study of the effect of neutron irradiation at operating temperature on the mechanical properties of both cold-worked and fully annealed Zircaloy-2 has shown that it is permissible to use cold-worked materials in a reactor. Furthermore, mechanical tests show that a design stress of 13,500 lb/in.^{2} (9.5 kg/mm^2) is conservative and that this can almost certainly be raised to 16,000 to 18,000 lb/in.^{2} (11 to 13 kg/mm^2). In an attempt to find a zirconium alloy with corrosion properties comparable to those of Zircaloy-2 but with better mechanical properties, alloys of Zr-2.5 wt.% Nb containing 0 to 1.5 wt.% Sn are being investigated. These alloys are exhibiting acceptable corrosion rates (two to three times that for Zircaloy-2), indications of a lower hydrogen pick-up and better mechanical properties. Zirconium alloys with good mechanical properties but poor corrosion resistance are also being investigated in preparation for the possible production of duplex tubing that uses some other corrosion-resistant alloy as the cladding. (auth)

23897 ARGONARC-WELDING OF ZIRCALOY-2 TUBES. G. Schneider (Degussa, Wolfgang, Ger.). p.271-3 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

In producing Zircaloy-2 canned fuel elements the economical fabrication of large numbers of uncontaminated uniform welds appears to be of considerable importance. The procedures of loading, welding, and cooling have to be properly adjusted, in order to have low time-consumption, low expenses and little scrap. Besides the dependence on the quality of the Zircaloy, this is mainly a problem of the design of the welding equipment. The necessity of filling a rather large volume with expensive inert gases creates a disadvantage. This difficulty can be avoided by separate welding of each individual fuel-rod in a small chamber. Welding with this method is described. (auth)

23898 PRODUCTION PICKLING OF ZIRCALOY CLADDING. L. Hydén (Svenska Metallverken, Västerås, Sweden). p.247-9 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

Preparing Zircaloy-clad fuel elements for autoclave corrosion testing involves a pickling procedure generally performed in a mixture of nitric acid and hydrofluoric acid. An applied technique is described for the production pickling of R3/Adam fuel segments (OD 18.6 mm, L 750 mm) comprising subsequent rinsing operations. (auth)

23899 FABRICATION OF A COMPARTMENTED FLAT-PLATE CERAMIC FUEL ELEMENT. S. J. Paprocki, E. S. Hodge, P. J. Gripshover, and D. C. Carmichael (Battelle Memorial Inst., Columbus, Ohio). p.283-300 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

A Zircaloy-clad flat-plate compartmented UO_2 fuel element is proposed for the second Shippingport PWR core loading. This is a high-performance fuel element having several important advance design features. The ceramic UO_2 core is thin; consequently, the element possesses a large surface to volume ratio and high specific power output for a ceramic fuel, without center melting of the fuel or temperatures so high that fission gas release is excessive. The compartmentation of the fuel has the advantage of incorporating high-strength gas-tight compartments for the containment of fission gas and the isolation of clad failures to a small volume of the contained fuel. The fuel plates in this core will be approximately 135 mils thick, 5 in. wide, and 102 in. long. The UO_2 platelets are 100 mils thick, $\frac{1}{4}$ in. wide, and $1\frac{1}{2}$ in. long. The plates are clad with Zircaloy-4 and are compartmented with zirconium dividers 35 mils wide. A gas-pressure-bonding process involving essentially no metal deformation is developed. In this process, all of the fuel element components are assembled, sealed, and then bonded in helium gas at a pressure of 10,000 psi and a temperature of 1550°F. The bond characteristics are found to be good when the components to be bonded are clean and moderately rough. Methods for accomplishing this are developed and are described. The bonding process is dependent on the attainment of intimate contact between the Zircaloy surfaces to effect diffusion and bonding. This also results in an intimate contact between the Zircaloy and the UO_2 fuel, and reaction between them, requiring that the UO_2 be coated with a barrier layer. A 20 to 50μ coating of electroplated or evaporated chromium film on UO_2 with bonding done below the zirconium-chromium eutectoid temperature will satisfactorily prevent the UO_2-zirconium reaction. A second satisfactory barrier material is carbon. Satisfactory fuel plates are produced up to 4 × 40 in. incorporating approximately 350 individual fuel compartments. The plates which are produced have performed satisfactorily in Bettis capsule and loop testing, in defected and undefected corrosion tests, in mechanical tests, and metallographic tests. (auth)

23900 WELDING OF CAPS AND CLADDING OF ALLOYS OF MAGNESIUM. P. Thome and C. Bridoux (Centre d'Études Nucléaires, Saclay, France). p.301-24 of "Fuel

Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In French)

This study is undertaken in connection with the fabrication of fuel elements for the initial charge of the EdF1 reactor. The cladding material adopted is a 0.6% Mg–Zr alloy whose mechanical, metallurgical, and corrosion-resistance properties are thoroughly studied. Arc welding of the material does not give rise to difficulties provided that argon and tungsten electrode are used. Cap-drawing tests by an increasing-load series of load-non-load cycles show that the break occurs in the usual way by shearing, with an elongation double that occurs in machined test-bars. The quality of the welds after a 2-mm deformation at 400°C, in relation to the method of welding and the stiffening effect of the fins, is studied. This deformation has no effect on the impermeability of the weld which deforms plastically together with the can resistance to withdrawal. The mixed welding of creep-resistant Mg–Mn alloy caps on the Mg–Zr can in no way affects the mechanical strength of the joint or the weldability and properties; a coarse-grain microstructure in the molten zone is, however, to be noted. (auth)

23901 THE FABRICATION OF CLAD MASSIVE UO_2 FUEL ELEMENTS BY HOT COEXTRUSION. A. Kaufmann, P. Lowenstein, and J. Hunt (Nuclear Metals, Inc., Concord, Mass.). p.325-41 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

The multitemperature coextrusion method for metals was applied to the hot extrusion of UO_2 bodies with the object of fabricating economic metal-clad oxide fuel elements with desirable irradiation properties. The coextrusions produced oxide rods clad with stainless steel, graphite overlaid with stainless, or tantalum. The fabrication variables encompassed billet cores of UO_2, either porous or dense, that were heated either bare or contained. The dense cores were made by hot pressing ADU ceramic grade oxide to bodies 2 in. in length and 95% of theoretical density. Cores were preheated to between 800° and 2500°C prior to insertion in mild steel billet shells preheated from 640° to 935°C. The billet diameter was held at 2.800 in., while two oxide diameters, 0.875 and 1.500 in., were used. Billet reductions were 2.0 to 22.0 times, ram forces from 200 to 600 tons, while ram speed was held constant at about 130 in./min. Chemical removal of the outer steel shell was accomplished in hot nitric acid. Using arbitrarily selected transverse and longitudinal sections, the appearance and approximate dimensions for approximately thirty-five coextrusions are reported. The best seven coextrusions display very dense oxide centers, roughly cylindrical, 0.250 to 0.350 in. in diameter, and 15 to 40 in. in length. The clad thickness over a centrally located half length falls between 0.010 and 0.040 in., but in any one coextrusion it appears to vary by less than a factor of two. The average density of the fuel in 1 in. long samples ranges from 91.3 to 100% of theoretical density. The oxygen-to-uranium ratio in the same coextrusions is indicated not to exceed 2.10. (auth)

23902 CLADDING BY CASTING AND FABRICATION OF TRIPLE PLATES WITH A BASE OF Al–U ALLOY. E. Jonckheere, B. Defreyn, Ph. Van Asbroeck, J. Flipot, J. Van Geel (Centre d'Études de l'Énergie Nucléaire, Mol, Belg.). p.343-71 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In French)

The Al covering is cast round the Al–U alloy and the slug thus formed is laminated until the required thickness is obtained. The effect of the casting and laminating conditions on the quality of the end product is discussed. Certain other parameters are studied and, as a result, a few changes were made in the components. (auth)

23903 FABRICATION OF FUEL ELEMENTS AT TROMBAY, INDIA. B. Prakash and N. K. Rao (Atomic Energy Establishment, Trombay, India). p.391-402 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

The design and lay-out of a plant at Trombay for the fabrication of uranium fuel elements are presented. The main functions of the plant are: development of methods for alloying, casting, fabrication, machining, canning and assembling fuel elements; and manufacturing full-scale reactor charges either in pilot operation or as a sustained operation. The building for the plant, 240 ft × 100 ft, is provided with special features, designed for protection against health and fire hazards. The layout of the equipment which provides for processing from uranium ingots to the finished fuel elements is described. Facilities are installed for vacuum melting and casting, forging, rolling, heat-treating and machining uranium prior to canning the fuel. For quality control, non-destructive testing techniques are adopted. After commissioning the equipment, a prototype fuel element for the Canada-India reactor was made in June, 1959, and at present, fuel elements for the first charge are under fabrication. The operating experience gained so far and the technological problems encountered are discussed. The cost figures are briefly presented. (auth)

23904 FACILITIES FOR THE FABRICATION OF BERYLLIUM. P. B. Eyre (United Kingdom Atomic Energy Authority, Risley, Warrington, Eng.). p.403-17 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

The precautions necessary to eliminate the potential toxic and fire hazards during handling and storage of beryllium and its compounds are described. The design and location of the plant and buildings are chosen, after careful consideration of the possible accident conditions, both to limit the level of contamination within the plant and to reduce the risks of outbreak and spread of fire. The precautions used to protect personnel in the operation of the plant are discussed. These depend on good ventilation and efficient filtration of the air effluent. Work is proceeding favorably on the development of an instantaneous monitoring device, which would help to establish confidence in the use of external laboratory facilities for development work. Safe protection from the toxic effects of beryllium is an important factor in the cost of the plant. (auth)

23905 THE MANUFACTURE OF MATERIALS TESTING REACTOR FUEL ELEMENTS IN THE UNITED KINGDOM. M. Macphee, D. S. Oliver, H. Lloyd, and M. A. Warne (Dounreay Experimental Reactor Establishment, Thurso, Scotland and Marston Excelsior, Ltd., Wolverhampton, Eng.). p.419-42 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

An account is given of the manufacture of fuel elements for use in water-moderated and cooled materials testing and research reactors. The nuclear, heat transfer, safety and other criteria for such fuel elements are discussed briefly and two types of element in current use are described. The first is of the type used for research reactors, or materials testing reactors in which the materials irradiation experiments are carried out external to the fuel elements: whilst

the second is specially designed to permit irradiation experiments under conditions of high flux within the fuel element itself. The production process is given, and includes a description of the mechanical and metallurgical aspects of fuel plate manufacture by casting, rolling and cladding by roll bonding. The procedures adopted for the assembly of the fuel plates into complete fuel elements by flux bath dip brazing and more conventional techniques are described. The inspection procedures controlling nuclear and chemical cleanliness, dimensional accuracy, and mechanical soundness are included; and reference is made to administrative features of the process peculiar to work with highly enriched fissile material, such as the prevention of criticality incidents, and to the methods used to maintain a knowledge of the identity of the material at all stages. (auth)

23906 WELDING OF THIN-WALLED STAINLESS STEEL TUBING. R. H. Søvik (Institutt for Atomenergi, Kjeller, Norway). p.443-9 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

A welding procedure for making sound and reliable joints between stainless steel tubing with a wall thickness of 0.25 mm and end-closure plugs is developed. Welding equipment, weld defects and methods by which these defects are overcome, are described. Likewise, some comments are made on constructional problems in connection with plug design. The welded specimens are subjected to different tests, destructive and nondestructive, and satisfactory results are obtained. Satisfactory service performance in high temperature, pressurized water is to be expected. (auth)

23907 FABRICATION OF FUEL ELEMENTS FOR THE REBUS REACTOR. E. Jonckheere, F. Gorle, J. Van Audenhove (Centre d'Études de l'Énergie Nucléaire, Mol, Belg.). p.451-66 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In French)

The REBUS reactor is a small experimental reactor of the swimming-pool type with a nominal capacity of approximately 25 kw. The fuel element is made of enriched UO_2 dispersed in graphite. The graphite blocks, of square section, are stacked in an aluminum (or Al–Mg alloy) can. There is a description of the methods of impregnating the graphite, and of the welding processes used to obtain a partial vacuum (one-third to one-half atmosphere) within the can. (auth)

23908 FUEL AND BLANKET ELEMENTS FOR THE EXPERIMENTAL BREEDER REACTORS. R. Macherey (Argonne National Lab., Ill.). p.467-94 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

The fabrication, jacketing, assembly, welding, and bonding of the Mark I, II, and III loadings of Experimental Breeder Reactor I (EBR–I) and the Mark I loading of EBR–II are described. Inspection techniques employed in the evaluation of the elements, reactor performance of the EBR–I fuels, and irradiation results from test elements are also described. In addition, the trends in future high burnup fuel elements for EBR–II are discussed. (auth)

23909 METHOD OF WELDING BY ELECTRON BOMBARDMENT APPLIED TO THE CLADDING OF METALS. J. Van Audenhove, M. Meulemans, D. Tytgat, and E. Jonckheere (Centre d'Études de l'Énergie Nucléaire, Mol, Belg.). p.495-523 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In French)

The electron beam welding equipment is described. The process is applied to the closure of the Al cylindrical can of BR-1 fuel elements. The operation and the various tests are also described (mechanical test, leak test, metallography). The behavior of the plug after hot pressing of the can on the nickel-coated uranium is discussed. The welding specifications of various metals, such as stainless steel and zirconium, are described. (auth)

23910 KINETICS OF HOT PRESSING. J. D. McClelland (Atomics International, Canoga Park, Calif.). p.157-71 of "Powder Metallurgy." Werner Leszynski, ed. New York, Academic Press, 1961.

Hot pressing of powdered materials can be adequately described using a plastic flow theory proposed by Mackenzie and Shuttleworth for sintering. The present derivation assumes that the principal driving force for the closing of pores is the applied hydrostatic pressure instead of the surface tension of the pores. This pressure term, when corrected for the density of the compact, can be substituted for the surface tension term in the original derivation. The resultant equations give the rate of densification of the material in terms of a yield point and a viscosity. The equations predict that an endpoint density will be reached which is dependent upon the applied pressure and the yield point of the material. The effect of temperature and pressure on the rate of densification of beryllia powder compacts was obtained experimentally. The pressures ranged from 1000 to 2000 psi, the temperatures from 1200 to 1700°C, and the time from 15 to 240 min. The curves show a steep initial rate of densification followed by a gradual approach to the nearly asymptotic endpoint density. The theoretical equations are found to describe successfully the densification rates observed in beryllia when reasonable values of the yield point and viscosity are assumed. (auth)

23911 THE LATEST DEVELOPMENTS OF THE S.A.P. PROCESS. E. A. Bloch and H. Hug (Aluminium-Industrie-Aktien-Gesellschaft, Neuhausen am Rheinfall, Switzerland). p.371-85 of "Powder Metallurgy." Werner Leszynski, ed. New York, Academic Press, 1961.

For the practical manufacturing of S.A.P. semi-finished products, a heavy oxide-containing aluminum powder is used; its flakes are cold welded. Each powder particle already shows dispersion hardening. Sintering in the strict sense (shrinking and consolidation of the compact) does not take place in the case of S.A.P. However, the oxides undergo a transformation at a temperature ranging from 525 to 550°C. The powder particles will only weld together by hot forming (hot upsetting and extruding). Electron micrographs of oxide replicas show that the oxide is embedded in the metal ground mass in the form of platelets of 100 to 500 A thickness. There is no well-defined relation between the mechanical properties and the volume fraction of the oxide as the former depends to a great degree on the fineness of the dispersion of the oxide particles. The workability of S.A.P. increases with decreasing oxide content. A material of 7% oxide content, for instance, allows the manufacture of rather complicated forms by hot and cold forming. Pressure welding is possible below the melting point of aluminum. (auth)

23912 LARGE SINTERED BODIES AND PARTS. F. Emley (Westinghouse Electric Corp., East Pittsburgh, Penna.). p.389-401 of "Powder Metallurgy." Werner Leszynski, ed. New York, Academic Press, 1961.

The various powder compaction proccesses are reviewed in regard to the largest sizes of parts which are made commercially by each technique. Limitations and potential

sizes which could be produced by each process are discussed. The present status of processes for continuous compaction is presented along with a discussion of potential applications. (auth)

23913 SLIP CASTING OF METAL POWDERS AND METAL-CERAMIC COMBINATIONS. Henry H. Hausner (Polytechnic Inst. of Brooklyn) and Arnold R. Poster. p. 461-506 of "Powder Metallurgy." Werner Leszynski, ed. New York, Academic Press, 1961.

Detail is given as to the variables of the ceramic process, materials used, molds, and methods of casting. Although there are many similarities between the process for slip casting ceramics and metals, certain physical and chemical differences between the materials have required some departures in handling metal powders. Particle size and size distribution, density, oxide content, and surface area differences are discussed. Metal powder slips are composed of essentially three components: metal powder, a vehicle, and special additives. The possible movement of particles in the slip, during casting, is discussed. A number of factors are found to influence the stability of the slip and of the resulting casting. Among these are: liquid-to-metal ratio, type and amount of binders and deflocculants, particle morphology, oxide content of the powder, and agitation speed and time of the slip and stability of the slip with time. Examples of the effects are given for stainless steel, molybdenum, and tungsten powders. Also discussed are the effects of these variables on the slip cast and sintered metal. Variables associated with drying and sintering of the slip cast part are also given. Comparisons are given between the properties of loose or uncompacted powder, slip cast, and pressure compacted powders. Properties of some of the materials which are slip cast and sintered are discussed. Among these are stainless steel, W, Mo, Ti, Ta, as well as certain cermets such as stainless steel–uranium dioxide and chromium–aluminum oxide. Photomicrographs of some of these are shown. Some actual parts which have been fabricated by metal powder slip casting are briefly discussed. (auth)

23914 HOT EXTRUSION OF METAL POWDERS. P. Loewenstein, L. R. Aronin, and A. L. Geary (Nuclear Metals, Inc., Concord, Mass.). p.563-83 of "Powder Metallurgy." Werner Leszynski, ed. New York, Academic Press, 1961.

Variables of the extrusion process, such as temperature and reduction ratio and their effect on the properties of the resulting product are discussed. A number of applications to specific powder materials are given; these are divided into three types. The first is metal powders mixed mechanically with other materials to obtain special properties. Examples of this type are dispersion-type nuclear fuel elements such as uranium dioxide dispersed in an aluminum or stainless steel matrix, and cermets such as beryllium oxide. A technique to produce extremely homogeneous bodies by the co-called "chip method" is described. The second type of powder extrusions are those using a dispersion-hardening phase. The best known of these is the oxide dispersion-strengthened aluminum (S.A.P.) product. Similar principles applied to Mg, Ni, Cu, Fe, and Mo are discussed. The third type uses pure metal or alloy powders and forms these into usable shapes. This may have advantages over conventional methods such as melting which may be difficult and result in large grain sizes, or because the powder extrusion method is convenient and allows great flexibility as well as high yields. Examples of this last type are extrusions of Be and Cr. The advantages of the powder extrusion method are discussed, and areas where further development is needed are pointed out. (auth)

23915 ZIRCONIUM BEARINGS AND PROCESS OF PRODUCING SAME. (to Atomic Energy of Canada Ltd.). British Patent 870,170. June 14, 1961.

A production method and the design of a tubular zirconium bearing is presented. The bearing is subjected to approximately 800°C for a period of approximately two hours for oxidizing the zirconium. A tight adherent surface layer of monoclinic zirconium dioxide of distinctive blue-black color and of a thickness ranging from 0.0002 inches to 0.0015 inches is formed. The surface layer has a density of 5.31 g/cc. (N.W.R.)

23916 BERYLLIUM BRAZING. Denzil Malcolm Atkinson (to Associated Electrical Industries, Ltd.). British Patent 870,780. June 21, 1961.

A method of brazing beryllium to another metal is described. The method consists of interposing a brazing solder containing 55 to 70% silver, 20 to 30% copper, and 10 to 20% palladium between the beryllium and a metal to which the beryllium is to be brazed. The assembly is heated in a vacuum of high purity hydrogen to between 830 and 840°C for five minutes to cause interdiffusion to take place between the beryllium and the solder. The temperature is raised to 910°C for one minute to produce a brazed joint, and is finally rapidly cooled to 700°C. (N.W.R.)

23917 MOULDED GRAPHITE BODIES FOR SLOWING DOWN AND REFLECTING NEUTRONS, AND PROCESS OF MAKING SAME. Herbert Greiner (to Graphitwerk Kropfmühl, A. G.). British Patent 871,068. June 21, 1961.

The design and process for making moulded bodies of crystalline flaky graphite for slowing down and reflecting neutrons is presented. The crystalline flaky graphite has a density of 1.8 g/cc and is of high purity. The flakes lie parallel and are substantially free of interstices. Voids are filled with either a graphite material of low neutron absorbing power, or polytetrafluoroethylene. Various means are described for moulding the graphite in the various shaped bodies. (N.W.R.)

23918 IMPROVEMENTS IN OR RELATING TO GRAPHITE. John Malcolm Hutcheon (to United Kingdom Atomic Energy Authority). British Patent 871,616. June 28, 1961.

A method for producing high-density carbon bodies with reduced permeability is given. The method consists of maintaining a temperature gradient within a performed permeable carbon body, such that the surface is at a temperature below that at which cracking of a gaseous carbonizable compound occurs. Part of the body is at a temperature above that at which the cracking occurs. The gaseous compound is then supplied to the surface area. The carbon body is in the form of a graphite rod or tube. For the tube the gaseous carbonizable compound, propane, is applied to the inner surface which is below the cracking temperature with the outer surface being above the cracking temperature. (N.W.R.)

23919 IMPROVEMENTS RELATING TO METHODS OF MAKING NEUTRON-ABSORBING DEVICES. David Kenneth Worn and Ralph Edward Buttress (to International Nickel Co. (Mond) Ltd.). British Patent 872,060. July 5, 1961.

A fabrication method for a neutron-absorbing device is described. A mixture of the material that forms the matrix and the neutron-absorbing phase in powder form is packed between inner and outer tubes and the assembly is drawn through a die over a mandrel in successive reduction stages. The assembly is annealed at a high temperature between successive reductions so that the constituents of the neutron-absorbing body are bonded together by sintering.

The tubes are of stainless steel or other corrosion-resistant alloys. (N.W.R.)

23920 IMPROVEMENTS IN SINTERING PROCESS. Ronald Andrew Knight (to United Kingdom Atomic Energy Authority). British Patent 872,714. July 12, 1961.

A method of sintering uncompacted sinterable powders to produce a sintered object is described. The method consists of filling the powder into a mold having a core. The core has a melting point above the pre-sintering temperature of the powder and below the sintering temperature of the powder. The powder is heated in the mold at the pre-sintering temperature until the powder has sufficient cohesion to maintain its shape when unsupported. The temperature is raised above the melting point of the core and the molten core is removed from the mold. The powder is heated at a sintering temperature above the pre-sintering temperature to form the sintered object. The core defines the bore of the tube. The material may be beryllium powder. (N.W.R.)

23921 METHOD OF BONDING. (to U. S. Atomic Energy Commission). British Patent 872,930. July 12, 1961.

A process for bonding metals or ceramics to metals by hydrostatic pressure is described. The process consists of assembling the materials in close proximity, evacuating the space between the materials, coating the materials with a material to prevent chemical reaction if necessary, and sealing the space surrounding the assembly by an inert gas under superatmospheric pressure. The assembly is heated to the plastic flow point of one of the materials but below the melting point of any of the metals for a period of time sufficient to form an integral bond between the materials. The assembly is then cooled to room temperature. The following materials were bonded by this method: uranium–zirconium alloy to zirconium or zirconium-base alloy, uranium to zirconium, nickel to zirconium or uranium alloy, uranium oxide to graphite-coated zirconium, and metal hydride to molybdenum-coated stainless steel. (N.W.R.)

Properties and Structure

23922 (57GL139) INVESTIGATION OF SLIDING CHARACTERISTICS OF SEVERAL HIGH TEMPERATURE ALLOYS AT TEMPERATURES UP TO 1600°F. M. B. Peterson (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Apr. 8, 1957. 39p.

Sliding tests were run with representative cobalt, nickel, and iron base combinations at 80 and 1600°F on a low-speed friction apparatus. Temperature cycle tests were made on these materials, and several possible solid lubricants were investigated. The following results were obtained: (1) Stellite 6 gave the best performance at both 80 and 1600°F. (2) Up to 1200°F, considerable surface damage resulted with Inconel X and other Ni–Cr alloys. Above 1200°F, friction and wear reduced, and this effect is attributed to the oxide film. (3) Stainless steels appeared unsatisfactory. (4) Oxidized copper plate and cobalt oxide gave surface protection at 1600°F. (auth)

23923 (ABMA-DSN-TN-1-60) SINTERED ALUMINUM ALLOYS. F. C. Eddens (Army Ballistic Missile Agency, Redstone Arsenal, Ala.). Jan. 18, 1960. 14p.

A new class of Al alloys manufactured by the process of sintering Al powder together with hardening agents is described. High temperature applications are suggested by the unique properties. Physical and mechanical properties are given in tabular and graphic form. (auth)

23924 (AD-237461) DEVELOPMENT OF ULTRA REFRACTORY MATERIALS. Progress Report No. 21, February 1, 1960–April 30, 1960. Peter T. B. Shaffer (Carborundum Co. Research and Development Div., Niagara Falls, N. Y.). May 16, 1960. 23p.

Additional basic information was obtained on refractory systems from which materials suitable for use in air at temperatures in excess of 3500°F for periods up to one hour may be developed. Aspects of the study included: strength as a function of temperature, structure, and fabrication; applications as a coating material; attempts to improve the high temperature strength; and a study of the causes of wide variation in oxidation in different lots of material. Results show that bodies consisting of zirconium diboride containing 10 mole % molybdenum disilicide have excellent oxidation and thermal shock resistance. High-temperature strengths were lower than desired, though. Designs are shown for high temperature modulus of rupture apparatus, an induction heated inert atmosphere dilatometer, and apparatus for measuring elastic modulus by sonic techniques. (P.C.H.)

23925 (AD-249674) EVALUATION OF THE PRODUCIBILITY OF TWO NEW TITANIUM BASE SHEET ALLOYS, Ti–7Al–12Zr AND Ti–5Al–5Zr–5Sn. Fourth Bi-Monthly Report, Period Covered September 1, 1960–October 31, 1960. T. Vretas (Republic Steel Corp. Titanium Research Lab., Canton, Ohio). Nov. 4, 1960. Contract NOas 60-6035-C. 19p.

The final processing of the three 0.050-in. × 24-in. × 60-in. titanium alloy sheets which were produced previously using three different finish hot rolling temperatures was completed. Each of these sheets, being in the mill annealed condition, was evaluated with respect to tensile and bend properties. Surface contamination data as indicated by microhardness tests were obtained for the "as hot rolled" and "finished" sheet product made. The data were rather erratic in nature and indicated that surface contamination was evident in both sheet conditions to a depth of about 0.002 in./0.003 in. Using material from the finished sheet product, a total of 0.004 in. was pickled off the gage to note the effect of additional surface removal on the bend properties. A series of specimens were annealed from 1450 to 1700°F at 50°F intervals to evaluate by means of microstructure examination the recrystallization temperature for the Ti–7Al–12Zr alloy type. The times at temperature varied from one to eight hours. Melting of the first 200 pound double vacuum melted ingot of the Ti–5Al–5Zr–5Sn alloy type was accomplished and is presently being scheduled for forging to slab product. The production of hot rolled sheet product from the other Ti–7Al–12Zr forged slab, Heat XT-70018, was scheduled. Depending upon the amount of material available, hot rolling of the four gage sizes 0.080, 0.060, 0.040, and 0.020 in. is being considered. Chemical analyses results are reported for the second Ti–7Al–12Zr ingot, Heat XT-70018. (auth)

23926 (AD-253352) A SELECTED GUIDE TO BERYLLIUM LITERATURE. Marnelle Kinney (Autonetics Div., North American Aviation, Inc., Downey, Calif.). Mar. 16, 1961. 178p. (EM-6558).

A general survey of the unclassified literature on beryllium published between the years 1945 and 1960 is presented. Major subject headings are: general literature; alloys and compounds; beryllium copper; chemical, physical, and mechanical properties; electroplating; fabrication; toxicity; powder metallurgy; and literature surveys. There are 491 references arranged alphabetically by title in each

category. Author, periodical, and source indexes follow the references. (auth)

23927 (AEEW-M-118) THE PHYSICAL PROPERTIES OF SANTOWAX 'R' FOR HEAT TRANSFER CALCULATIONS (AERE R/M 183 REVISED). R. W. Bowring, D. A. Garton, and J. H. Kinneir (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England). Mar. 1961. 47p.

Values of the following physical properties of Santowax 'R' are presented in graphical and/or tabular form in both English and metric units: vapor pressure, specific heat, enthalpy, density, dynamic viscosity, kinematic viscosity, thermal conductivity, Prandtl number, surface tension, latent heat of vaporization, critical properties, and gas solubilities. The data were obtained by new experimental measurements, by calculation, or from the published literature. Wherever possible an estimate of the probable error is given. Conversion factors and tables are also presented to facilitate the conversion of any of the properties to convenient units required for calculations. (auth)

23928 (AERE-R-3493) THE MAGNETIC PROPERTIES OF NICKEL OXIDE DURING REDUCTION. T. I. Barry (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). October 1960. 6p.

The magnetization of nickel oxide was studied during its reduction by hydrogen. The occurrence of ferromagnetism was observed to be proportional to the extent of reduction in the initial stages. No induction period was observed. (auth)

23929 (APEX-475(Del.)) CHEMISTRY AND METALLURGY OF YTTRIUM. C. R. Simmons, E. S. Funston, C. B. Magee, J. A. McGurty, and V. P. Calkins (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 1958. Decl. with deletions Oct. 27, 1959. Contracts AF 33(600)-38062; AT(11-1)-171. 106p.

The development of the technology of yttrium is discussed. Recent data are given on the procurement and separation of yttrium oxide, and the preparation of the metal. Known physical, mechanical, nuclear, chemical, and metallurgical properties of yttrium and some of its compounds and alloys are presented. Present fabrication techniques for forming yttrium metal are described. (auth)

23930 (BM-RI-5789) HIGH-TEMPERATURE HEAT CONTENTS AND ENTROPIES OF CERIUM DIOXIDE AND COLUMBIUM DIOXIDE. E. G. King and A. U. Christensen (Bureau of Mines. Berkeley Thermodynamics Lab., Berkeley, Calif.). Oct. 1960. 9p.

Experimentally determined heat content and corresponding entropy increment data for cerium and niobium dioxides in the temperature range from 298 to 1800°K are presented in tabular form. Equations were derived to represent the heat contents and heat capacities. The data for niobium dioxide showed two previously unreported anomalies at 1090 and 1200°K. (auth)

23931 (CF-60-8-15) ANALYSIS OF ORNL DATA ON THE RELEASE OF FISSION GASES FROM UO_2. J. L. Scott (Oak Ridge National Lab., Tenn.). Sept. 21, 1960. 43p.

In order to establish optimum design criteria for the release of fission gases from UO_2 three independent studies were conducted at ORNL. These studies include neutron activation tests, capsule irradiations in the Oak Ridge Research Reactor (ORR) and the Low-Intensity Test Reactor (LITR), and the instantaneous fission-gas release experiment. The data obtained from these studies are analyzed in terms of the equivalent sphere model for fission-gas release. Results showed that the value of D' for xenon and krypton at 1400°C is in the range 10^{-10} to 10^{-14} sec^{-1} and that for design purposes the activation energy for the diffusion of fission gases in UO_2 may be assumed to be 70 kcal/mole. Above 1600°C the rate of release is higher than that predicted on the basis of diffusion alone as a result of grain growth and sublimation. Therefore above 1600°C it is best to assume that all of the fission gas will be released. It was also found that there is no effect of burnup on the rate of release at a given temperature up to a burnup of at least 16,400 Mwd/ton of UO_2. (auth)

23932 (CRGM-1013) TENSILE PROPERTIES OF NPD-2 PRESSURE TUBES. A Statistical Analysis. J. Veeder (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 1961. 28p. (AECL-1247)

The statistical analysis was made of the mechanical properties of the NPD-2 pressure tubes which can be used as a guide in establishing a working design stress of the CANDU tubes provided these tubes are manufactured to the same specifications. A study of the rejection rate of NPD-2 tubes indicated that setting the design stress for CANDU tubes in the range 16,000 to 16,500 lb/in^2 would result in the acceptably low rejection rate of 1 to 4%. To raise the design stress still further it is recommended that an alloy of higher intrinsic strength, such as Zr–2.5 Nb, be used. (auth)

23933 (CW-R&DL-14) ANNUAL REPORT ON BERYLLIUM RESEARCH, 1960. W. D. Bennett (Canadian Westinghouse Co., Ltd. Research and Development Labs., Hamilton, Ont.). Feb. 1961. 56p. (AECL-1236)

Beryllium research is described. Results of mechanical tests are shown graphically and interpreted in terms of modern dislocation theory. A marked alignment of the basal planes was observed not only in the extrusion direction but also in the radial direction. The effects of three different heat treatments on mechanical properties were investigated. A sharp rise in the ductility between 100 and 300°C suggested that a brittle-ductile transition occurs in this region. Stress rupture tests were extended to cover temperatures of 400, 500, 620, and 700°C. It was found that, for materials of the same average grain size, water quenching gave the highest rupture life at all stresses. The main characteristics of the stress rupture properties at 400 and 500°C was the scatter. Specimens subjected to different heat treatments were examined by bright field illumination and by polarized light and in all cases no difference in structure was observed. Modern dislocation theories are discussed. Pressure welding was demonstrated as a satisfactory method for joining beryllium within the size limitations of the equipment. Tests were begun on the corrosion of beryllium in water. An explanation of the brittle-ductile transition and the yield point phenomena was suggested on theoretical grounds in terms of dislocation-impurity interaction. (M.C.G.)

23934 (DMIC-Memo-111) THE EMITTANCE OF STAINLESS STEELS. W. D. Wood, H. W. Deem, and C. F. Lucks (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). June 12, 1961. 69p. (PB-171630)

A compilation of original test data on emittance, reflectance, and absorptance of stainless steels is presented. The data were taken from literature published during the period 1940 through 1959, and from some 1960 literature. Data are presented graphically. Curves are shown which are thought to indicate the most probable values for the various conditions and values. (J.R.D.)

23935 (DMIC-Memo-112) REVIEW OF RECENT DEVELOPMENTS IN THE EVALUATION OF SPECIAL METAL PROPERTIES. J. E. Campbell (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). June 27, 1961. 12p.

A review of current developments in techniques for testing of materials is presented. Also included are test results and information on sources of special test procedures. Information which became available to DMIC from March through May 1961 is the basis of the review which is developed mainly on evaluation of materials at low temperatures. Results of tests on aluminum alloys at −423°F are included along with similar tests on stainless steel. (J.R.D.)

23936 (DMIC-Memo-113) A REVIEW OF RECENT DEVELOPMENTS IN TITANIUM AND TITANIUM ALLOY TECHNOLOGY. R. A. Wood (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). July 3, 1961. 6p.

Selected information on new developments in Ti metallurgy that became available to DMIC from March 1961 through May 1961, is reviewed. (J.R.D.)

23937 (DMIC-Memo-117) REVIEW OF RECENT DEVELOPMENTS IN THE TECHNOLOGY OF HIGH-STRENGTH STAINLESS STEELS. D. A. Roberts (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). July 14, 1961. 5p.

A brief summary is presented of recent developments on high-strength stainless steels and related alloys included in information received by DMIC during the period April 1 to June 30, 1961. (J.R.D.)

23938 (DMIC-Memo-118) REVIEW OF RECENT DEVELOPMENTS IN THE METALLURGY OF HIGH-STRENGTH STEELS. H. J. Hucek and A. R. Elsea (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). July 21, 1961. 3p.

A list of 57 developments in the metallurgy field during the period April 1, 1961, to June 30, 1961, is given. A report on the tempering of chromium steel at 600 and 1100°F is discussed. The properties of chromium steel are given, and it is shown that a lower tempering temperature gives increased strength. (N.W.R.)

23939 (DP-551) X-RAY DIFFRACTION STUDIES ON ZIRCONIUM AND ZIRCALOY-2. A Literature Search. Myra S. Feldman (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). May 1961. Contract AT(07-2)-1. 44p.

References (85) on crystal structure, phase transition, preferred orientation, deformation characteristics, recrystallization, and effects of impurities are included from ACR 1954-Feb. 1960; American Society of Metals Lit. 1954-1958; AEC Card Catalog Metallurgical Abstracts Sept. 1953-1958; and NSA 1951-Jan. 1960. (P.C.H.)

23940 (GAMD-1037) POSSIBLE METALLIC MATERIALS FOR MGCR APPLICATION. Paul D. Wright (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Oct. 19, 1959. Contract AT(04-3)-187. 11p. (MGCR-M-239)

Possible metallic materials that may be applied to the MGCR problem and the risks involved in their application are discussed. Alloys of Fe, Ni, Nb, Mo, and W were investigated and a graphic summary of stress-rupture data for the best alloys is included. Analysis indicated that the error introduced by using extrapolated data increased as the difference between the experimental rupture time and the extrapolated rupture time increased. They also indicated that this error was greater the higher the stress level of extrapolation. It was found that the iron-base alloys do not possess adequate high temperature strength to be applied as reactor internal structures unless they are exposed only to inlet conditions. It was concluded that a nickel-base alloy can be applied to the core internal structure especially if a casting can be used. Data indicated that the only metallic solution to core internals exposed to exit gas conditions is probably a refractory metal base alloy. (M.C.G.)

23941 (GEAP-3201-2(Suppl.)) RELATIVE EFFECTIVENESS OF REACTOR CONTROL MATERIALS. (SUPPLEMENT). Walter R. Morgan, John L. Russell, Jr., and William C. Ballowe (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Jan. 11, 1961. Contract AT(04-3)-189. 21p.

Measurements were made on Li^6, Ag−In−Cd mixtures, EuB_6−Cu−stainless steel sandwiches, 0.161-in. B_4C and Dy_2O_3 rods, and were repeated for Au, B, Er_2O_3, and Tb_4O_7. The data are presented in tables giving relative worth and equivalent surface density of boron. Graphs plotting relative worth vs. sample surface density and sample surface density vs. boron equivalent surface density are presented. (auth)

23942 (GEAP-3626) METALLOGRAPHY OF THE BORIDES. Donald R. Lewis (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Jan. 9, 1961. Contract AT(04-3)-189. 20p.

A description is given of the preparation and etching techniques studied for borides produced by vacuum hot pressing and vacuum arc melting. The examination and hardness testing of the finished specimens are discussed. Micrographs are included showing the structures of the prepared specimens. (B.O.G.)

23943 (ISC-1159) EFFECTS OF DEFORMATION ON SUPERCONDUCTING METALS. Victor Walter Hesterman and C. A. Swenson (Ames Lab., Ames, Iowa). Nov. 1958. Contract W-7405-eng-82. 52p.

An a-c mutual inductance method was used to measure the effects of deformation on the superconducting critical field curve for tin. The deformation was produced by pushing on the ends of a cylindrical sample which had a length-to-diameter ratio of unity. It was found that a 2% deformation produced no change in the shape of the critical field curve but shifted it upward by about 1.5 gauss. (auth)

23944 (LMSD-48472) BERYLLIUM DESIGN DATA. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Apr. 29, 1959. Contract NOrd 17017. 84p.

A handbook is presented to provide a single source of reliable data for use in the design of parts fabricated from Be. The handbook is expandable and is arranged in sections on basic mechanical and physical properties, joint and fastener properties, fatigue properties, and dynamic properties. (J.R.D.)

23945 (MIT-1113(Del.)) TECHNICAL PROGRESS REPORT FOR THE PERIOD APRIL 1953 THROUGH JUNE 1953. (Massachusetts Inst. of Tech., Cambridge. Metallurgical Project). Sept. 4, 1953. Declassified with deletions Feb. 1, 1960. Contract AT(30-1)-981. 215p.

A laboratory study of process variables in the production of extruded Be powder was carried out. It appears that the achievement of high ductility is not a sensitive function of extrusion conditions and thermal history. This conclusion needs to be verified for large-scale extrusions. X-ray preferred orientation studies showed that cross rolling of extruded Be flats to a reduction of about nine times causes the great majority of basal plants of the various crystals to lie in the plane of the sheet. Zone

melting of Be leads to extensive purification with respect to Si, Al, and Cr, but little effect on Fe, Ni, Cu, Mn, and C. Alpha-extruded U develops a coarse non-equiaxed grain structure when extruded at high velocities and high reductions. Water quenching at the die exit prevents the coarse grain size. Preliminary work has shown that sandwich tubes of Al with Al–U alloy can be made by coextrusion with a bond between the "meat" and the clad. Apparatus for hot tensile testing of U and Zr and their various alloys at elongation rates up to 30 inches/inch/second was constructed. It is hoped that results will lead to improved understanding of the behavior of these metals during coextrusion. Hardness measurements of uranium billets have shown a great variability of hardness from crystal to crystal which appears to correlate with interface irregularities in coextruded rods. Radiator structures of the type desired by Dow-Detroit were filled with U–Cr alloy to depths of six inches. Zr is quite resistant to the molten alloy and will be used for further studies of radiator castings. The technique used for a successful extrusion of one ton of Th on a commercial press is described. Cermets of BeO with Be and with third elements were made and studied. Properties such as density, strength, shear modulus, thermal conductivity, and thermal expansion were measured. It appears that high density compacts can be made with up to seven percent Be metal. These appear to have appreciably greater thermal shock resistance than pure BeO. Certain ternary cermets with Si or Mo appear to have even better thermal shock resistance. A new type of vacuum furnace for high temperature melting is described and some performance data are given. (auth)

23946 (NDA-2141-1) SOLUTION RATES AND EQUILIBRIUM SOLUBILITY OF NICKEL AND IRON IN LIQUID LITHIUM. B. Minushkin (United Nuclear Corp., White Plains, N. Y.). June 30, 1961. Contract Nonr-2857(00) Amend I. 43p.

The equilibrium solubility and solution rates of nickel and iron in lithium were measured in the temperature range from 540 to 825 and 662 to 760°C, respectively. The solution rates and solubility data were obtained by measuring the solute concentration, as a function of time of contact, using a liquid sampling technique. The equilibrium solubility-temperature relationship for nickel in lithium in the temperature range studied is accurately represented by $\log_{10} C_0$ (ppm Ni) = 8.44 – (4600/T(°K)). The equilibrium solubility of iron in lithium was 27 ppm at 662°C and 85 ppm at 760°C. Both nickel and iron dissolved in lithium at a very high rate within the temperature ranges investigated. Saturation of the experimental system, which had a surface area-to-volume ratio of 0.57 cm^{-1}, occurred in less than ½ to 1½ hr. The solution rate constants, α, which characterize the dissolution process for nickel were calculated from the concentration-time data using the equation $(dC/dt)_1 = \alpha_1 (A/V)(C_{s1} - C_1)$. The solution rate constants for nickel in lithium, stirred at 54 rpm (0.22 ft/sec linear velocity), were 19 cm/hr at 680°C, 29 cm/hr at 730°C, and 39 cm/hr at 780°C. A higher stirring rate of 485 rpm (2.0 ft/sec) increased the solution rate constants by 20 to 25% within approximately the same temperature range. The solution rate constant for iron in lithium at 662°C under nominally static conditions was estimated to have a lower limiting value of 2.5 to 3.0 cm/hr. The upper limit or the true value at 662°C could not be obtained from the present data. Stirring increased the solution rate constants of both nickel and iron. The solution processes, therefore, are believed to be at least partially "diffusion limited" over the range of temperature and stirring rates investigated. (auth)

23947 (NMI-1238) IMPURITY EFFECTS IN COMMERCIALLY PURE BERYLLIUM. S. H. Gelles and A. K. Wolff (Nuclear Metals, Inc., Concord, Mass.) Feb. 10, 1961. Contract AT(30-1)-1565. 75p.

An investigation was conducted to determine the role of impurities in beryllium. It was found that the properties of beryllium can be altered by aging treatment. The rate at which aging proceeds was determined by resistivity measurements which were related to changes in mechanical properties observed after various aging treatments. X-ray measurements related the aging process to the growth of one or more types of precipitate. The identification of the precipitates by Debye-Scherrer X-ray technique has proved elusive, although electron microbeam probe work on solution-treated and solution-treated-and-aged samples has shown segregation of iron, aluminum, and silicon to the grain boundaries of the beryllium during the aging process. Preliminary bend and tensile tests conducted at room temperature on single crystals of beryllium resulted in the following observations: (1) Relatively impure material: (0001) fracture, and (0001), $[10\bar{1}0]$, and $[10\bar{1}1]$ slip; and (2) Material vacuum-melted from Pechiney flake: critical resolved shear stress for basal plane slip, 1100 psi. (auth)

23948 (NMI-1243) DEFORMATION MODES OF ZIRCONIUM AT 77°K, 300°K, 575°K, and 1075°K. E. J. Rapperport and C. S. Hartley (Nuclear Metals, Inc., Concord, Mass.). Oct. 6, 1960. 37p. Contract AT(30-1)-1565.

A study was made of the deformation processes active in zirconium crystals deformed at 77, 300, 575, and 1075°K. The specimens were large-grained samples of relatively high purity and wide orientation distribution. The only slip system observed at any of the temperatures was of the form $(10\bar{1}0)$ $[\bar{1}2\bar{1}0]$ with a critical resolved shear stress of about 1.0 kg/mm^2 in tension at 77°K, 0.65 kg/mm^2 in compression at 300°K, 0.20 kg/mm^2 in tension at 575°K, and 0.02 kg/mm^2 in tension at 1075°K. The slip planes were found by the usual two-trace techniques and the slip direction found from a detailed analysis of Laue spot asterism. The active twin planes were $\{10\bar{1}2\}$, $\{11\bar{2}1\}$, $\{11\bar{2}2\}$, and $\{11\bar{2}3\}$, with varying frequencies at the different test temperatures. The most active at all temperatures was $\{11\bar{2}1\}$, with $\{11\bar{2}2\}$, $\{11\bar{2}3\}$, and $\{10\bar{1}2\}$ twins unobserved at 1075°K The absolute thicknesses of the twin families at each temperature were measured and compared with the twinning shears for the contributing families to yield deviations from the generalization that the twinning shear is inversely related to the twin breadth. (auth)

23949 (NMI-1244) HIGH STRENGTH ZIRCONIUM-BASE ALLOYS. G. A. Henrikson (Nuclear Metals, Inc., Concord, Mass.). Feb. 22, 1961. Contract AT(30-1)-1565. 26p.

An evaluation was made of the mechanical and corrosion properties of certain high-strength zirconium alloys for possible use as structural or fuel element cladding materials. The zirconium alloys studied were prepared by double consumable electrode arc melting followed by extrusion and included: Zr–3 wt % Mo–2 wt % Al, Zr–5 wt % Mo–2 wt % Al, Zr–7 wt % Mo–2 wt % Al, Zr–1 wt % Mo–5 wt % Al, Zr–3 wt % Mo–5 wt % Al, Zr–7 wt % Sn–1.5 wt % Al, and Zr–7 wt % Sn–2.5 wt % Al. Tensile measurements at room temperature were made on these alloys as-extruded, solution treated, and after aging at 600°C for 1 to 1000 hr. In addition, tensile measurements were made at 600°C on samples aged for 1000 hr at 600°C. Corrosion tests in 680°F water (6 days) and 750°F steam (3 days) were made on as-extruded samples. Room temperature yield strength values, elongations at fracture, and yield strength values obtained

at 600°C are given. The Zr–5 wt % Mo–2 wt % Al and Zr–7 wt % Mo–2 wt % Al alloys exhibited some corrosion resistance, whereas the other alloys spalled badly under the test conditions. (auth)

23950 (NMI-2095) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report for March 1961. (Nuclear Metals, Inc., Concord, Mass.). May 19, 1961. Contract AT(30-1)-1565. 25p.

Progress on the hot extrusion of uranium dioxide, preparation of honeycomb fuel, yttrium fabrication, U^{233} recycle, hydrostatic fabrication, corrosion studies of zirconium alloys, and beryllium research is reported. (M.C.G.)

23951 (NMI-2096) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY, PROGRESS REPORT TO THE UNITED STATES ATOMIC ENERGY COMMISSION FOR APRIL, 1961. (Nuclear Metals, Inc., Concord, Mass.). June 7, 1961. Contract AT(30-1)-1565. 21p.

Honeycomb-type Fuel Elements. An Al-clad Al–16 wt % U plate with 36 Al–0.8 wt % Mg core inserts was rolled. The equipment for punching fuel plates and plugging the holes with core inserts is described. Attempts to form the fuel plate into a spiral are described. Yttrium Fabrication. The results of extrusion of Y billets and tube drawing and swaging experiments are reported. Metallographic examination of Zircaloy-2-clad Y after heat treatment at 900 and 1000°C for times up to 225 hr gave no evidence of Zircaloy-Y reaction. U^{233} Recycle. The conclusions reached by a series of meetings on problem areas are briefly summarized. They treat input fuel shipment, fuel shielding, and fuel allocation of core loadings for efficient use of irradiated U^{233}. Hydrostatic Fabrication. The results of extrusion of Be billets into rods, using water as the pressure medium, are reported. Corrosion of Zirconium Alloys. The behavior of Zr intermetallic compounds with H_2 and O_2 is described. Oxygen gradients in corroding Zr alloy samples exposed to steam were investigated. Crack formation in the oxide films was studied. (D.L.C.)

23952 (NMI-9512) BERYLLIUM RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period, January 1, 1961 through March 31, 1961. S. H. Gelles (Nuclear Metals, Inc., Concord, Mass.). July 7, 1961. Contract AF33(616)-7065. 121p.

Progress in beryllium research is reported on preparation by the iodide decomposition method, ultrasonic welding, the role of oxides and voids, dislocations, surface damage, brazing, resistance welding, distillation, evaluation of products, aging and strain aging, and raising the yield strength. (M.C.G.)

23953 (NP-9527) THE INTERNAL CARBURIZATION AND OXIDATION OF NICKEL–CHROMIUM ALLOYS IN CARBON MONOXIDE TYPE ATMOSPHERES. Technical Paper 297. B. E. Hopkinson and H. R. Copson (International Nickel Co., Inc., Research Lab., Bayonne, N. J.). Mar. 29, 1960. 25p.

Studies were made of the effects on internal oxidation of mixtures of CO with other gases to determine the effects of temperature on the rate of attack and to investigate the range of conditions under which additions of Nb, Ti, and Si are beneficial. Tabulated results show that decomposition decreases fairly rapidly with temperature from 87.65% CO at 1470°F to 99% at 1830°F. The optimum conditions for internal oxidation require the formation of a gas mixture containing 3 to 13% CO_2. Nb and Ti apparently prevent internal oxidation over the range of temperatures and gas compositions used. The role of catalysts and the beneficial effect of Si is also discussed. (P.C.H.)

23954 (NP-9531) INVESTIGATION OF THE EFFECTS OF PROCESSING VARIABLES AND FABRICATION TECHNIQUES UPON THE PROPERTIES OF INTERMETALLIC COMPOUNDS. Technical Report No. 185. Progress Report No. 1, April 1, 1960–June 30, 1960. R. Truesdale, B. Lympany, J. Klein, M. Hornak, and W. W. Beaver (Brush Beryllium Co., Cleveland). July 15, 1960. Contract AF33(616)7108. 34p.

Initial investigations were conducted on $NbBe_{12}$, Nb_2Be_{17}, and Nb_2Be_{21}. These compounds were first prepared by reacting the metal powders, then analyzed and used in the fabrication studies. Sintering studies were conducted on cold-pressed specimens of the niobium beryllides to evaluate the variables of sintering temperature, cold-compacting pressure, binder bake-out, and mesh size. Hot-pressed specimens of these materials were prepared for the metallurgical processing phase. Some of the variables studied were jacketing material, handling technique, and preliminary upsetting procedure. A 500-lb impact tester was constructed for the upsetting study. (auth)

23955 (NP-9564) I. RESISTIVITY MEASUREMENTS DURING CREEP OF ALUMINUM–MAGNESIUM ALLOYS. II. EFFECT OF COLD WORK ON THE CREEP-RUPTURE PROPERTIES OF NICKEL. Final Report. Charles Stein, W. Michael Yim, and N. J. Grant (Massachusetts Inst. of Tech., Cambridge). [1960]. Contract NOnr-1841(28). 15p.

An investigation was made to determine the effectiveness of prestraining and polygonization treatments in improving the creep strength of Ni. At 700°F, for the prestrained specimens without polygonization treatment, the strength increased as the level of prior cold work increased. For the polygonized specimens, however, strength improvement was not obvious. At 1300°F, with up to 2% prestrain, no strengthening was observed. However, beyond a prestrain level of 4%, it appeared that a strength gain was achieved by the prestrain-polygonization treatment. A study of the creep of Al and Al–Mg alloys is being conducted in which resistivity measurements are made during elongation, in an effort to understand the various modes of deformation which are occurring. Graphs are shown of the nature of the change in restivity with strain. (M.C.G.)

23956 (NP-10216) DEVELOPMENT OF TANTALUM–TUNGSTEN ALLOYS FOR HIGH PERFORMANCE PROPULSION SYSTEM COMPONENTS. Quarterly Report No. 7, October 10, 1960 to January 9, 1961. M. L. Torti (National Research Corp., Cambridge, Mass.). Contract NOrd 18787. 23p.

A series of Merm nozzles were carburized and sent for test firing under A-3 conditions. The cross-section of a carburized pure tantalum nozzle successfully test-fired under A-2 conditions shows the carbide to be relatively unaffected by the firing. Merm nozzles $\frac{1}{8}$ and $\frac{1}{4}$ in. thick of tantalum 20– and 30%–tungsten were machined and sent for test firing. Continued work on fabrication and ductility of tantalum–20% tungsten is described. The microstructure of the tantalum–10% hafnium–5% tungsten is described and the rolling results for the tantalum–10% hafnium are reported. (auth)

23957 (NP-10341) DEVELOPMENT OF TUNGSTEN-BASE ALLOYS. Final Report covering Period June 1958–December 1960. M. Semchyshen and Robert Q. Barr (Climax Molybdenum Co. of Michigan. Research Lab., Detroit). Contract NOas 58-847-c. 135p.

Results are presented of a preliminary evaluation of arc-

cast, tungsten-rich binary alloys containing various quantities of Al, Cr, Co, Nb, Hf, Fe, Ni, Si, Ta, V, or Zr. The studies were conducted primarily on as-cast materials. Areas of special interest included relations between room and elevated temperature hardness versus alloy composition, characteristics of macro- and microstructures as a function of alloy composition, and solid solubility limits. Other activity was devoted to determination of alloy composition effects on lattice parameter and oxidation, and assessment of workability as function of alloy composition. Graded-composition ingots were prepared for the experimental program by consumable arc melting of preformed W electrodes while adding the second alloying element by means of a supplementary feeding system. Uniform-composition ingots were also used and were cast in a press-sinter-melt apparatus in which blended charges of metal powders were compacted into an electrode which was sintered to increase its strength, then arc-melted in a water-cooled mold. Charts are included which illustrate the effects of alloy additions on the lattice parameter, hardness, and oxidation resistance of these alloys. (J.R.D.)

23958 (NP-10353) RESEARCH ON INORGANIC STRUCTURAL ADHESIVES FOR HIGH TEMPERATURE METALS. Progress Report No. 1, Covering February through April 1961. John B. Whitney and Robert Boisvert (Boeing Co., Wichita, Kan.). Contract AF33(616)-7852. 36p.

Combinations of ceramic adhesives and Ni-base brazing alloys were studied for bonding super alloys and refractory metals. Lap shear strengths of 15,000 to 20,000 psi were obtained with A-286 panels. The effects of variables on bonding and the compatibility between brazing alloy and ceramic adhesive were studied. A literature survey on high-temperature brazing alloys suitable for metal bonding is included. (D.L.C.)

23959 (NP-10364) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Virginia L. Adams, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). June 1961. 64p.

A listing of selected documents and journal articles, with abstracts, on Co alloys, Ni alloys, steels stainless steels, Fe alloys, Be, Ti, Mg, Nb, Cr, Mo, Ta, W, Pt group, cermets, reinforced plastics, graphite, special refractories, ceramic oxides, coatings, and applications is presented. Author, numerical, and subject indexes are included. (M.C.G.)

23960 (NP-10374) MONTHLY PROGRESS REPORT ON PYROLITIC CARBIDE DEVELOPMENT, MAY 1961. (High Temperatures Inc., Brighton, Mass.). May 31, 1961. Contract NOw 60-0292 (FBM). 10p.

Two symmetric Polaris nozzles were coated with tantalum carbide. Process parameters were investigated to determine optimum coating conditions and injector design changes were made to improve the quality of the carbide produced. Niobium carbide coated ARC nozzles and a tantalum carbide coated nozzle were produced and submitted for evaluation. Additional data for pyrolytic niobium carbide and hafnium carbide are presented in this report. (auth)

23961 (NP-10383) RARE EARTH INTERMETALLICS. Bi-monthly Report No. 3, March 15 to May 15, 1961. (Research Chemicals, Inc., Burbank, Calif.). Contract NOw 61-0257-c. 14p. (RC-179)

Intermetallic compositions of Hf–B and Y–P were prepared by arc melting procedures. Samples of Hf, Mo, Y, and Zr were coated with phosphorus. It was found that the phosphorus coating inhibited corrosion until sufficient oxidation had occurred that the material underneath the coating separated the phosphide surface from the sample. Corrosion studies of B–Hf samples showed a decrease in corrosion as a function of boron content, when the boron content was greater than 4%. (M.C.G.)

23962 (NP-10389) PROGRESS REPORT NO. 4 [ON PHYSICAL METALLURGY]. (Canadian Uranium Research Foundation, Toronto). June 27, 1961. 4p.

Studies were carried out on the effects of uranium additions to steels. The properties studied include corrosion, deoxidation, mechanical properties, and heat treatment. Some preliminary data on deoxidation of copper by uranium are reported. (D.L.C.)

23963 (NP-10409) GALLIUM BIBLIOGRAPHY, 1950-1959. (ANNOTATED; CLASSIFIED, INDEXED). M. W. Brennecke (Aluminum Co. of America. Alcoa Research Labs., New Kensington, Penna.). 125p.

References (1261) are given from U. S. and foreign journals, abstract journals, U. S. patents, books, and individual papers published from 1950 to 1959. Author and subject indexes are included. (P.C.H.)

23964 (NP-10410) ALUMINA PROPERTIES. Technical Paper No. 10, Second Revision. J. W. Newsome, H. W. Heiser, A. S. Russell, and H. C. Stumpf (Aluminum Co. of America. Alcoa Research Labs., [New Kensington], Penna.). 1960. 88p.

Literature values for the properties of the aluminas are compiled critically. The historical development of the names for the many varieties is traced, and the systems of nomenclature are compared. Three major classifications are distinguished: the high temperature forms that are produced in general by calcination over 1200°C, the transition forms, and the hydrates. For each phase the following information is assembled if it is available: occurrence in nature; preparation; crystal structure; and optical, thermal, electrical, magnetic, mechanical, and surface properties. The interesting phase transformations are given particular attention. Alcoa Activated Alumina is discussed separately with emphasis on its structure and its applications in drying, chromatography, catalysis, and oil maintenance. Commercial forms and uses of Alcoa Calcined, Tabular, and Hydrated Aluminas are also described. In many cases the data are summarized in figures and tables. An extensive bibliography and subject index are included. (auth)

23965 (NP-10412) GALLIUM BINARY PHASE DIAGRAMS. Technical Paper No. 16. E. H. Wright and L. A. Willey (Aluminum Co. of America. Alcoa Research Labs., New Kensington, Penna.). 1960. 13p.

A compilation of phase diagrams is presented for binary Ga alloys containing the following metals: Ag, Al, As, Au, Bi, Cd, Co, Cu, Ge, Hg, In, Mg, Na, Ni, Pb, Pr, Sb, Si, Sn, Te, Tl, and Zn. (D.L.C.)

23966 (NP-10413) PROGRESS REPORT NO. 12, [PROPERTIES OF CARBONS AND GRAPHITES], APRIL 1, 1961–JUNE 30, 1961. J. F. Andrew, J. Distante, N. Juul, H. E. Strauss, and T. Tsuzuku (Buffalo. Univ.). July 15, 1961. Contract AF33(616)-7791. 31p.

Results of further studies on variation in room-temperature Young's modulus with heat treatment are reported for impregnated carbon rods. Heating and cooling curves for the dependence of the Young's modulus on temperature with consecutive higher and higher temperature treatments are given for a hard filler-hard binder carbon. Temperature dependence of the Young's modulus was investigated for four basic carbon types which were heat treated to 3000°C.

In other work, research on the dependence of conductivity on temperature is reported. (J.R.D.)

23967 (NYO-9834) PROGRESS REPORT ON PLUTONIUM BEARING GLASS, JULY 1960–MARCH 1961. L. V. Jones (Mound Lab., Miamisburg, Ohio); P. Lockwood and R. Tiede (Owens-Corning Fiberglas Corp. [Technical Center], Granville, Ohio); P. Harteck and S. Dondes (Rensselaer Polytechnic Inst., Troy N. Y.). July 1, 1961. Contract AT(30-3)-321. 8p.

Work accomplished in incorporating plutonium oxide in glass and glass fibers between July 1960 and March 1961 is summarized. The purpose of producing plutonium bearing glass and glass fibers was to eliminate or reduce the radiological and toxicological hazards associated with plutonium. Initial results using "wipe" tests showed no removable alpha contaminant in freshly prepared samples. Leaching studies were made using water, dilute HCl, and HNO_3. The amount of PuO_2 leached from the glass can be greatly reduced by substituting Al_2O_3, CaO, and K_2O for much of the Na_2O component in the glass composition. (auth)

23968 (SRI-9-P) DIFFUSIONAL TRANSPORT OF ATOMIC HYDROGEN THROUGH MOLECULAR HYDROGEN AT ELEVATED TEMPERATURES. Henry Wise (Stanford Research Inst., Menlo Park, Calif.). Dec. 1960. Contract Nonr 1858(25), NR-098-038. Project SQUID. 14p.

Changes in the transport properties of a gas mixture of atomic and molecular hydrogen were measured from 300 to 700°K. The steady-state distribution of atoms diffusing from a source towards a catalytically active surface was determined in a cylinder of finite length. The experimental parameter of interest is the diffusion Reynolds number which contains the ratio of interdiffusion coefficient to recombination coefficient. If the catalytic activity of the surface is known, the atom-concentration gradient may be related to the diffusion coefficient. In the region studied the change in the binary diffusion coefficient for the system H, H_2 was evaluated. Based on the results obtained, the intermolecular force fields applicable to the atom-molecule encounters were examined. (auth)

23969 (TID-7610(p.7-22)) THE DIFFUSION BEHAVIOR OF FISSION XENON IN URANIUM DIOXIDE. W. H. Stevens, J. R. MacEwan, and A. M. Ross (Atomic Energy of Canada Ltd., Chalk River, Ont.).

The diffusion of Xe^{133} from uranium dioxide was studied by vacuum annealing small samples following short irradiations. An oxidized surface layer was found to be a major cause of the rapid release of X^{133} which normally occurs at the beginning of a diffusion anneal. The temperature dependence of diffusion in sintered and single-crystal material was investigated between 1000° and 1500°C. For single-crystal UO_2 the diffusion of Xe^{133} was characterized by the equation. $D = 2.4 \exp(-120{,}000/RT)$ cm^2/sec. A correlation was found between Xe^{133} release at 1400°C and the density of sintered uranium dioxide. The dependence was related to the pore morphology as observed by electron microscopy. (auth)

23970 (TID-7610(p.63-82)) DIFFUSION OF CHROMIUM IN NICKEL-BASE ALLOYS. W. R. Grimes, G. M. Watson, J. H. DeVan, and R. B. Evans, III (Oak Ridge National Lab., Tenn.).

The self-diffusion coefficients of Cr^{51} in Inconel and INOR-8, which are alloys suitable for uses at high temperatures, were measured by contacting the alloys with fused salt mixtures containing radioactive chromous fluoride. These data are pertinent to the interpretation of corrosion behavior occurring in polythermal systems consisting of molten fluorides contained in nickel-base alloys. The experiments were designed to provide data over the temperature range of 600 to 900°C, where relatively low diffusion coefficients (10^{-10} to 10^{-12} cm^2/sec) were obtained. The validity of the use of the self-diffusion coefficients to predict chromium migration under corrosive conditions were experimentally demonstrated in the case of INOR-8. (auth)

23971 (TID-7610(p.147-56)) PHASE BEHAVIOR OF MOLTEN FLUORIDE FUELS, BLANKETS, AND COOLANTS. R. E. Thoma, H. Insley, H. A. Friedman, and C. F. Weaver (Oak Ridge National Lab., Tenn.).

Phase data from polycomponent systems of fused fluorides for use in the Molten Salt Reactor Experiment are discussed. Mixtures of LiF and BeF_2 for use as the secondary coolant and as diluents for UF_4 and ThF_4 for the fuels and blankets were studied. Phase diagrams of the $LiF-BeF_2$, $BeF_2-LiF-UF_4$, $LiF-BeF_2-ThF_4$, BeF_2-ThF_4, and $LiF-ThF_4-UF_4$ systems are given. (M.C.G.)

23972 (TID-11919) THE DETERMINATION OF THE EQUILIBRIUM PHASE DIAGRAM, ZIRCONIUM–NIOBIUM. Interim Report No. 1. Ronald H. Cox and Charles E. Lundin (Denver. Univ. Denver Research Inst.). Aug. 1960. Contract AT(11-1)-752. 55p.

The phase relationships were determined by metallographic techniques with the auxiliary aid of hardness determination and incipient-melting techniques. A minimum in the liquid-solid boundaries occurs at 22 wt % niobium and 1740C. Complete solid solubility exists above 970C in the body-centered cubic phase. A monotectoid reaction exists at 20 wt % niobium and 610C. Solid solubilities at the monotectoid level are 0.6 and 85 wt % niobium, respectively. (auth)

23973 (TID-13031) ELECTRONIC BAND STRUCTURE OF CESIUM GOLD (thesis). Technical Report No. 12 [on] SOLID STATE PHYSICS PROGRAM. Van E. Wood (Case Inst. of Tech., Cleveland). Feb. 1961. Contract AT(11-)-623. 40p.

The lower-lying electron energy bands in CsAu arising from the levels of the valence electrons of the constituent atoms are computed using the method of matching wave functions at the surfaces of the atomic polyhedrons surrounding each atom. The radial parts of the wave functions required are determined by the quantum defect method. CsAu is assumed to be completely ionic. Calculations are carried out for the points in $\vec{k}$-space at the center of the first Brillouin zone and at its extrema in the [1 0 0] and [1 1 1] directions. The calculations indicate that CsAu is a semiconductor, in agreement with experiment, with a minimum energy gap, which is vertical, of about 2.3 ev located at the extremum of the [1 1 1] direction of the first zone. Limitations and some possible extensions of the calculations are discussed. (auth)

23974 (TID-13032) ELASTIC CONSTANTS OF LITHIUM–MAGNESIUM ALLOYS. Technical Report No. 13 [on] SOLID STATE PHYSICS PROGRAM. Joseph Trivisonno (Case Inst. of Tech., Cleveland). Feb. 1961. Contract AT (11-1)-623. 32p.

The single-crystal elastic constants of dilute lithium–magnesium alloys were measured using the ultrasonic pulse-echo technique. In terms of dln C/dx, all fundamental elastic constants increase with composition by the following amounts: C_{44}, 1.22; C', 1.03; B_s, 1.2; per atom fraction. Small corrections for lattice parameter change upon alloying were made for C_{44} and C' by using the pressure derivatives of the elastic constants of pure lithium and the known variation of the lattice constant with composition. The re-

maining effect is ascribed to alloying. Both to understand the elastic shear constants of lithium and to comprehend their dependence on composition, small negative stiffness contributions arising in the Fermi energy must be included, in addition to the major and usual electrostatic stiffness. It is then possible to deduce the variation with composition of each contribution from the measured total variation for the two shear constants, with the result that $d\ln C_E/dx = 1.24$ and $d\ln C_F/dx = 1.76$. Both values are reasonable. (auth)

23975 (TID-13033) FIBER TEXTURE AND MAGNETIC ANISOTROPY IN IRON FILMS. Technical Report No. 14 [on] SOLID STATE PHYSICS PROGRAM. Arthur Yelon (Case Inst. of Tech., Cleveland). Mar. 1961. Contract AT(11-1)-623. 39p.

The fiber texture and uniaxial magnetic anisotropy of evaporated iron films was studied as a function of film thickness. It is found that there are three textures present: [110], [111], and [221]. In thin films, the [111] texture is dominant. It is found that the magnetic anisotropy is on the order of 2×10^4 ergs/cm^3 for 350-A films, and that it decreases for thicker films. On the basis of the experiment, and information from earlier experiments, several theories of the origin of magnetic anisotropy in films are examined, and shown to be inadequate for iron films. A theory for the origin of this effect is proposed, based primarily on the magnetic energy associated with an array of oriented vacancy needles. The vacancy needles can also qualitatively explain the resistivity anisotropy and dichroism. (auth)

23976 (TID-13034) TEMPERATURE DEPENDENCE OF MAGNETIZATION IN THIN NICKEL FILMS. Technical Report No. 17 [on] SOLID STATE PHYSICS PROGRAM. King H. Rosette (Case Inst. of Tech., Cleveland). May 1961. Contract AT(11-1)-623. 51p.

Thin nickel films, 248 A and less in thickness, were prepared by vacuum deposition at pressures of 10^{-7} mm. Hg. Torque measurements indicate a more rapid decrease of magnetization with temperature for decreasing film thickness. This agreement with the Glass-Klein theory contradicts the bulk behavior observed for nickel films prepared and measured at ultra-high vacuum by the same torque method. The presence of a surface layer, correlated with spin wave resonance experimental and theoretical results, suggests the importance of surface effects on spin wave excitation. It is possible that thermal excitation of spin waves is also dependent on surface conditions. (auth)

23977 (TID-13036) ANGLE OF INCIDENCE MAGNETIC ANISOTROPY IN EVAPORATED NICKEL FILMS. Technical Report No. 19 [on] SOLID STATE PHYSICS PROGRAM. Paul M. Schaible (Case Inst. of Tech., Cleveland). May 1961. 31p.

Evaporated nickel films are shown to display a magnetic anisotropy dependent on the angle of incidence of the arriving nickel vapor. An anisotropy energy density of 4 to 5×10^3 ergs/cm^3 was observed in samples deposited at angles of incidence of 10 to 15 degrees. A comparison with the observed magnetic anisotropy in iron suggests that an appropriate model for the angle of incidence effect should encompass a [1 1 1] fiber texture and a large contribution from demagnetization effects. (auth)

23978 (TID-13196) STUDY OF FACTORS INFLUENCING DUCTILITY OF IRON-ALUMINUM ALLOYS. Monthly Letter Report No. 1, June 1, 1961-November 30, 1961. George P. Rauscher, Jr. and Joseph F. Nachman (Denver. Univ. Denver Research Inst.). July 10, 1961. Contract AT(11-1)-742. 6p.

Studies are being made on the effects of variation of aluminum content, heat treatment, surface preparation, and other metallurgical factors on the room temperature ductility of Al-Fe alloys. The variation of Fe_3Al order as a function of temperature for 13.9 Alfenol was redetermined under constant instrumental conditions. The variation of the electrical resistivity of the three alloys under consideration with temperature on slow cooling is illustrated. An anomaly in the disordering process near the $Fe_3Al \rightarrow FeAl$ transformation temperature was manifested in the stoichiometric Fe_3Al alloy. Above a temperature of 490°C there was a rapid decrease in the integrated intensity of the (210) FeAl superlattice reflection. The best ductilities obtained corresponded to heat treatments involving slow cooling to produce a high degree of Fe_3Al order and subsequent annealing of the ordered material for short periods of time near the $Fe_3Al \rightarrow FeAl$ transformation temperature. (M.C.G.)

23979 (UCRL-9695) CRYSTAL STRUCTURE AND PHYSICAL PROPERTIES OF AMERICIUM METAL (thesis). Denis Bayman McWhan (California. Univ., Berkeley. Lawrence Radiation Lab.). May 1961. Contract W-7405-eng-48. 103p.

The methods for preparing milligram quantities of pure, well crystallized americium metal are discussed in detail. A versatile high and low temperature x-ray powder camera for small radioactive samples is presented. Americium metal prepared by the reduction of americium trifluoride with barium vapor was indexed as hexagonal close-packed with $a = 3.4681 \pm 0.0008$ Å and $c = 11.240 \pm 0.005$ Å at 20°C. The proposed structure type is that of lanthanum metal ($P6_3/mmc$ with metal atoms in 2(a) 000; $00\frac{1}{2}$ and 2(c) $\frac{1}{3}, \frac{2}{3}$, $\frac{1}{4}; \frac{2}{3}, \frac{1}{3}, \frac{3}{4}$). Americium metal condensed on a tantalum wire or quartz fiber from the vapor phase was found to be face-centered cubic ($a = 4.895 \pm 0.005$) Å with a density similar to the dhcp structure. Attempts to reproduce the low density double hexagonal close-packed structure with $a = 3.642 \pm 0.005$ Å and $c = 11.76 \pm 0.01$ Å failed. Evidence for the existence of a face-centered cubic form of americium metal above 600°C is presented. The following physical properties of americium metal were determined: melting point, 995 ± 4°C, density (x-ray), 13.671 ± 0.005 gm/cm^3 (20°C), and metallic radius (CN 12), 1.730 Å. (auth)

23980 (WADC-TR-56-110) INVESTIGATION DIRECTED TOWARD THE DEVELOPMENT OF CERAMIC COATINGS WITH HIGH REFLECTIVITIES AND EMISSIVITIES FOR USE IN AIR-CRAFT POWER PLANTS. Edward A. Douglas (Bettinger Corp., Waltham, Mass.). Feb. 1956. Contract AF33(616)-2376. 114p. (AD-116235)

Development of ceramic coatings possessing high reflectivities and emissivities was forestalled because of rapid oxidation of the low alloy steel base metal. Such oxidation of the low alloy steel base metal can be prevented if a neutral atmosphere furnace is used. Dark materials are high emitters, and white materials are low emitters. Emissivity values for dark materials varied from 0.86 to 0.98, and for white materials values were 0.22 to 0.69 with treopax, feldspar, and zirconium spinel having the lowest values. To develop a good ceramic coating for low alloy steels, aluminous and silicious mill added refractories should be used with high melting glasses. To then develop coatings possessing desirable radiation characteristics is a problem of choosing the proper composition of glass and refractories. (auth)

23981 (WADC-TR-58-360(Pt.III)) INVESTIGATION OF ELASTIC AND THERMAL PROPERTIES OF CARBON-BASE BODIES. S. Mrozowski, J. F. Andrew, N. Juul, H. E.

Strauss, and D. C. Wobschall (Buffalo. Univ. Carbon Research Lab.). Dec. 1960. Contract AF33(616)-5186. 54p.

The elastic properties and permanent set were investigated at room temperature for carbons made of graphitized filler and for carbons impregnated in the baked or graphitized state in dependence on the heat-treatment temperature. An apparatus for study of deformation at 1000 to 3000°C was built and calibrated and the first results for the variation of Young's modulus with ambient temperature were reported. Further studies of corrections to the heat conductivity from convection by gas across the pores were made and it is shown that such corrections are necessary even in the case of quite dense carbons. Transverse heat diffusivity was investigated at 700 to 2800°C by a transient state method, using a newly constructed apparatus; good fit with the previously found data in the low temperature range is obtained. (auth)

23982 (WADC-TR-59-744(Vol.IV)) INVESTIGATION OF FEASIBILITY OF UTILIZING AVAILABLE HEAT RESISTANT MATERIALS FOR HYPERSONIC LEADING EDGE APPLICATIONS. VOLUME IV. THERMAL PROPERTIES OF MOLYBDENUM ALLOY AND GRAPHITE. I. B. Fieldhouse and J. I. Lang (Illinois Inst. of Tech., Chicago. Armour Research Foundation) and H. H. Blau, Jr. (Little (Arthur D.) Inc., Cambridge, Mass.). Oct. 1960. Contract AF 33(616)-6034. 86p. (AD-249166)

The feasibility of utilizing heat-resistant materials in the fabrication of leading edges for hypersonic boost-glide vehicles was investigated. The results of measurements of the thermal conductivity, specific heat, linear thermal expansion, and emittance of a 0.5% titanium alloy of molybdenum, and of siliconized ATJ graphite as a function of temperature are presented. Emittance measurements were made on coated and uncoated materials. (auth)

23983 (WADD-TN-60-175) AEROTHERMODYNAMIC TEST OF 2000°F THERMAL INSULATION. Howard W. Jackson (Wright Air Development Div. Propulsion Lab., Wright-Patterson AFB, Ohio). June 6, 1960. 20p. (AD-249757)

Thermal insulation for the ANP Engine Development Program was tested to determine its structural reliability and thermal effectiveness in a gas stream of 2000°F and mach 0.6. Of 98 fasteners in the test sample, 24 failed during the 104.25 hours of testing. The insulation system remained intact throughout the test. A temperature drop of 1100°F and 718°F was measured across the 0.60 inch-wall with and without cooling respectively. (auth)

23984 (WADD-TR-60-566) SURFACE TENSION OF REFRACTORY METALS. S. Victor Radcliffe and H. Udin (Manufacturing Labs., Inc., Cambridge, Mass.). Aug. 31, 1960. Contract AF 33(616)-6269. 37p.

An electron-bombardment heating technique was applied to the measurement of the surface tension of solid niobium by a modification of the Udin method. The value obtained is 2100 dynes cm^{-1} at 2250°C in a vacuum of approx 10^{-5} mm. This result is consistent with a theoretical estimate and provides support for estimates of the surface tension of the refractory metals. From measurements of the dihedral angle of grain boundaries formed in niobium by thermal etching, the interfacial energy (γ') was computed to be 0.36 of the surface energy. An electrical-resistance heating technique was applied to the measurement of the surface tension of solid tungsten, molybdenum, and niobium by a modification of the Udin method. The method in this form was found to be unsuitable for these metals. (auth)

23985 (WADD-TR-60-749(Pt.I)) FACTORS AFFECTING THERMAL SHOCK RESISTANCE OF POLYPHASE CERAMIC BODIES. P. T. B. Shaffer, D. P. H. Hasselman, and A. Z. Chaberski (Carborundum Co. Research and Development Div., Niagara Falls, N. Y.). Jan. 1961. Contract AF33(616)-6806. 62p.

The factors affecting the thermal shock resistance of polyphase ceramic systems were studied with the model system zirconium carbide–graphite. Theoretical calculations of the individual material properties show that the included graphite particles may be regarded as spherical pores. Experiments were made which support the postulate that increased thermal shock resistance is a result of an increase in the ratio of strength over Young's modulus due to the addition of the low Young's modulus phase. (D.L.C.)

23986 (WADD-TR-60-825) REFRACTORY COATINGS FOR TUNGSTEN. C. G. Goetzel and P. Landler (New York Univ., New York). Nov. 1, 1960. Contract AF33(616)-6868. 42p.

A preliminary study of protection of W wires against oxidation at 1815°C was conducted. W wires coated with WSi_2 by the cementation method were found to resist oxidation at 1815°C in still air for periods up to 10 hr. However, the WSi_2 coatings are susceptible to oxidation when held at low temperatures (650 to 1250°C) for prolonged periods and are rather brittle. (D.L.C.)

23987 (WAL-TR-830.3/3) THE ROLE OF DILUTE BINARY TRANSITION ELEMENT ADDITIONS ON THE RECRYSTALLIZATION OF VANADIUM. Ernest P. Abrahamson, II (Watertown Arsenal Labs., Mass.). July 1961. 11p.

Cr, Fe, Co, Ni, Mo, Ru, Rh, Os, and Ir lower the recrystallization temperature, while Ti, Mn, Zr, Nb, Pd, Hf, Ta, W, Re, and Pt raise it. The majority of elements have their greatest effect in less than 0.15 atomic percent. Both the rate of change of recrystallization temperature with atomic percent solute and the limit of initial linearity are found to correlate with the free atom ground state outer electron configuration of the solute element. (auth)

23988 (WAL-TR-830.3/4) THE ROLE OF DILUTE BINARY TRANSITION ELEMENT ADDITIONS ON THE RECRYSTALLIZATION OF COLUMBIUM. Ernest P. Abrahamson, II (Watertown Arsenal Labs., Mass.). July 1961. 10p.

The elements Mn, Fe, Co, Ni, W, Re, and Os lower the recrystallization temperature, while Ti, V, Cr, Zr, Mo, Ru, Rh, Pd, Hf, Ta, W, Ir, and Pt raise it. A correlation is noted between the rate of change of recrystallization temperature with atomic percent solute and the free atom electron configuration of the solute element. (auth)

23989 (WAL-TR-830.3/5) THE ROLE OF DILUTE BINARY TRANSITION ELEMENT ADDITIONS ON THE RECRYSTALLIZATION OF ZIRCONIUM. Ernest P. Abrahamson, II (Watertown Arsenal Labs., Mass.). July 1961. 10p.

All additions raised the recrystallization temperature. A correlation is obtained between the logarithm of the rate of change of recrystallization temperature with atomic percent solute and the free atom ground state electron configuration of the solute element. (auth)

23990 (WAL-TR-851.4/1) OXIDATION OF PYROLYTIC GRAPHITE BETWEEN 1250°F AND 1850°F. Milton Levy (Watertown Arsenal Labs., Mass.). May 1961. 15p.

Oxidation was studied as a function of time and temperature. Pyrolytic graphite does not oxidize as rapidly as commercial graphite at temperatures below 1450°F but approaches that of commercial graphite at 1550°F. Oxidation of pyrolytic graphite proceeds preferentially in the c-direction. A break in the Arrhenius plot for pyrolytic graphite occurring at 1550°F may be attributed to the change in control mechanism from chemical reactivity to diffusion

control. An activation energy of 37180 calories per mole was calculated for a commercial graphite. The activation energy calculated for pyrolytic graphite was 23350 calories per mole. The lower activation energy for pyrolytic graphite is associated with a lower reaction rate. This anomalous behavior is attributed to lower porosity since a less porous material exposes a smaller surface area for molecular collisions. (auth)

23991 (AEC-tr-4060(p.233-6)) THE HALL EFFECT IN ALLOYS OF TITANIUM AND MOLYBDENUM. N. V. Grum-Grzhimailo and V. G. Gromova. Translated from Zhur. Neorg. Khim., 2: 2426-8(1957).

The Hall effect was measured in Mo–Ti alloys of varying compositions. Evidence was obtained supporting the existence of three compounds: Ti_4Mo, Ti_3Mo, and $TiMo_4$. (D.L.C.)

23992 (AEC-tr-4650) HEAT CONDUCTIVITY, SPECIFIC HEAT AND INTERNAL FRICTION OF GASES. A. Eucken. Translated from Physik. Z., 14: 324-32(1913). 16p.

Assuming a complete energy exchange during molecular collision, values were obtained for: for the translation energy factor K_t, 2.5; for the rotation energy factor K_r, 1; for the vibration energy factor K_s, 1 to 1.5. The value for the total energy was averaged from these values. Data obtained in a series of recent measurements of heat conductivity between 21 and 273° are tabulated. The observed values for K agree with those calculated in a number of cases, complete energy exchange. It is of particular interest that in the case of hydrogen the value of K, at very low temperatures, approaches 2.5, the value which holds for monoatomic gases. In some cases the observed K values were considerably lower than the calculated ones. In the case of helium the translation energy exchange was incomplete, especially at low temperatures. In the case of hydrogen sulfide, water vapor, ammonia, and carbon monoxide, the deviation between the calculated and observed values of K could probably be attributed to incomplete exchange of rotation energy. In the case of nitrogen, oxygen, and carbon monoxide, observations suggest that molecular heat decreases by 5 to 10% between 273 and 80°. In the case of methane there is evidently no decrease. Calculation of the Avogardo number, on the basis of Chapman's theory, yields an average value of 63×10^{22} for the gases N_2, O_2, Ar, CO_2. (auth)

23993 (AEC-tr-4657) CONCERNING THE VANADIUM–NITROGEN SYSTEM, METAL AMIDES AND METAL NITRIDES, XVIII. Harry Hahn. Translated from Z. anorg. u. allgem. Chem., 258: 58-68(1949). 11p.

In the vanadium-nitrogen system a new nitride phase of the composition $VN_{0.37-0.43}$ was found besides the already known VN. Pure VN was prepared by heating NH_4VO_3 in a stream of ammonia at 1000°C. The nitrogen deficient samples were produced by sintering VN and V metal together. The characteristics and densities of a series of nitride preparations are indicated. VN (gamma phase) is not a stoichiometric compound. It has a large region of homogeneity which extends from $VN_{1.00}$ to $VN_{0.71}$. The lattice constants decrease corresponding to the nitrogen content. $VN_{1.00}$: a = 4.126 A. $VN_{0.71}$: a = 4.064 A. The beta phase, $VN_{0.37-0.43}$ is a nitride of hexagonal intercalative structure, whose homogeneity range extends from 9.3 to 10.5% nitrogen. The lattice constants of the upper phase limits are a = 2.835, c = 4.541, and c/a = 1.602, the lattice constants of the lower phase limit are a = 2.831, c = 4.533, and c/a = 1.602. The solubility of nitrogen in vanadium metal could not be determined. (auth)

23994 (AEC-tr-4747) THE CONNECTION BETWEEN THE STRUCTURE AND THE ANISOTROPIC THERMAL EXPANSION OF URANIUM, NEPTUNIUM, AND PLUTONIUM. N. T. Chebotarev. Translated by S. J. Rothman from Atomnaya Energ., 10: 43-9(1961). 16p. (Includes Original 7p.).

The anisotropic thermal expansion of the non-cubic forms of U, Np, and Pu is analyzed by studying the rules according to which the interatomic distances change with temperature. For alpha U, its strong anisotropy in thermal expansion arises from the weakening of four covalent bonds with temperature increases and the unequal distribution of these bonds with respect to the crystal axes. The weak anisotropy of alpha Np is due to the projections of the short bonds being nearly equal. The strong anisotropy of gamma Pu is explained by the short bonds d_1 acting along the c axis, while the anisotropy is much less in alpha Pu. (D.L.C.)

23995 (AEC-tr-4748) RESISTANCE OF METALS AT HIGH CURRENT DENSITY IN AN IMPULSE SYSTEM. L. A. Ignat'eva (Ignatiev) and S. G. Kalashnikov (Kalashmikov). Translated by Al Monks (Oak Ridge National Lab.) from Zhur. Eksptl'. i Teoret. Fiz., 22: 385-99(1952). 37p.

An investigation was made of the electrical resistance of thin gold, silver, copper, platinum, and tungsten wires at current impulses of the order of several tens of microseconds and at a current density to 5×10^6 amp/cm^2, as a function of the energy introduced into the wire. It was found that the resistance for gold, silver, and copper in an impulse system coincides with that for weak currents. For platinum and tungsten at a current density above 1×10^6 amp/cm^2, a rapid increase in resistance, exceeding by several fold that for weak currents, is observed. The relative increase in resistance for platinum increases with a decrease in temperature. The curves showing the dependence of resistance on energy introduced are different for the various metals and manifest characteristic points corresponding to a phase conversion (melting). (auth)

23996 (AERE-Trans-864) THERMAL EXPANSION IN GRAPHITE CRYSTALS. E. Matsuyama. Translated by S. G. Brickley (Atomic Energy Research Establishment) from Tanso (Carbons), 7: No. 1, 12-15(1958). 9p.

A high temperature x-ray camera especially for use with graphite was made, and the values of c were determined between room temperature and 800°C. The results are combined with previous results and are shown in the form of a graph. The measured value at 300° to 500° are smaller than the calculated values, and the coefficients of thermal expansion calculated were not constant over the temperature interval. (P.C.H.)

23997 (CEA-tr-R-1235) PROPRIETES REFRACTAIRES DE L'ALLIAGE FERCHROME-ALUMINIUM NO. 2 AUX TEMPERATURES DE 600-1200°C. (Refractory Properties of Iron–Chromium–Aluminum Alloys No. 2 at Temperatures of 600-1200°C). V. S. Mikheev. Translated into French from Vestnik Sel'skokhoz. Nauki, Vsesoyuz. Akad. Sel'skokhoz. Nauk im. V. I. Lenina, 4: 64-73(1960). 23p.

The refractory properties of Fe-Cr-Al No. 2 (23 to 27% Cr, 4.5 to 6.5% Al, and 0.5% Ti) was studied at 600 to 1200°C at various bend stresses. The alloy in the cold worked state and annealed at 700°C and less, with fine grain from 0.001 to 0.002 mm^2, is deformed at a maximum speed with respect to the deformation speed of the alloy annealed at temperatures from 850 to 1000°C with grain from 0.009 to 0.05 mm^2. With increased anneal temperature and grain

dimension, the resistance to the action of the effort given is increased. The refractory properties of the alloy when bend deflection from 3 to 5 mm is attained at the end of 500 hr of test are characterized by the following stress limits in kg/mm²: 600°–4, 700°–1, 900°–0.3, 1000°–0.2, and 1200°C (300 test hr)–0.025. By using these values of the stress limits, the admissible stress of the alloy can be calculated. (tr-auth)

23998 (NP-tr-563) THE STRUCTURE AND PROPERTIES OF HEAT RESISTANT MATERIALS. Translated from Trudy Tsentral. Nauch.-Issledovatel. Inst. Tekhnol. i Mashinostroen., 93: 10-15; 33-60; 61-9; 70-98(1959). 98p.

Four papers are included which treat the effects of various additives on heat-resistant alloys. Separate abstracts have been prepared for each of the papers. (D.L.C.)

23999 (NP-tr-563(p.1-9)) ROLE OF THE α-PHASE IN THE RELAXATION RESISTANCE OF Ni–Cr–Al–Ti ALLOYS. V. Z. Tseilin and S. A. Yuganova. Translated from Trudy Tsentral. Nauch.-Issledovatel. Inst. Tekhnol. i Mashinostroen., 93: 10-15(1959).

The formation of the α' phase, composed of $Ni_2(Al,Ti)$, in Ni–Cr–Al–Ti alloys and the effects of heat treatments on the phase segregation and dispersion are discussed. The stress relaxation resistance of the alloys increases with the content of the α' phase, and a possible mechanism for this beneficial effect is proposed. The effects of Ti on the heat resistance and other properties of the alloys are discussed. (D.L.C.)

24000 (NP-tr-563(p.10-42)) THE EFFECT OF COMPOSITION ON THE STRUCTURE AND PROPERTIES OF AUSTENITIC IRON–CHROMIUM–NICKEL ALLOYS. I. L. Mirkin and M. I. Fantaeva (Fanatayeva). Translated from Trudy Tsentral. Nauch.-Issledovatel. Inst. Tekhnol. i Mashinostroen., 93: 33-60(1959).

Three series of alloys on a Fe–Cr–Ni base containing 16% Cr and 25, 32, and 40% Ni were studied with respect to the effects of alloying elements on the alloy structure and properties. The alloying elements studied included Mo, W, Nb, Ti, Co, and B. (D.L.C.)

24001 (NP-tr-563(p.43-59)) EFFECT OF COPPER ON THE PROPERTIES OF NICKEL-BASED ALLOYS. R. P. Zaletaeva (Zaletayeva). Translated from Trudy Tsentral. Nauch.-Issledovatel. Inst. Tekhnol. i Mashinostroen., 93: 61-9(1959).

The effects of Cu on the mechanical and high-temperature properties of Ni base alloys were studied. Cu was found to improve dutility during hot deformation and other mechanical properties. Alloying with more than 1% Cu is not recommended. (D.L.C.)

24002 (NP-tr-563(p.60-98)) INTERMETALLIC COMPOUNDS–LAVES PHASES–IN IRON–CHROMIUM NICKEL BASE ALLOYS WITH VARIABLE TUNGSTEN AND NIOBIUM CONTENT. S. A. Yuganova, M. D. Nesterova, and [N. A. Duel]. Translated from Trudy Tsentral. Nauch.-Issledovatel. Inst. Teknol. i Mashinostroen., 93: 70-98 (1959).

The phase compositions of alloys Fe–Cr–Ni based on 16% Cr and 32% Ni and additionally alloyed with W, Mo, Nb, Ti, and Al were studied. The behavior of the Laves phase type AB_2 was considered in detail. (D.L.C.)

24003 (NP-tr-626) CERTAIN PROPERTIES OF BORIDE ALLOYS OF REFRACTORY TRANSITION METALS. G. A. Meierson (Meyerson), G. V. Samsonov, R. B. Kotel'nikov, M. S. Voynova, I. P. Evteeva (Evteyeva), and S. D. Krasnenkova. Translated from Konferentsiya po Khimii Bora i Ego Soedineni, 58-73(1955). 27p.

Studies were made on TiB_2–CrB_2, TiB_2–W_2B_5, and ZrB_2–CrB_2 systems, on the phase composition and structures of the products of the diffusion reaction of the initial borides, the microhardness of the phases, and the corrosion resistance and structure of scales of various compositions. Descriptions are given of the methods for obtaining the borides, characteristics of the powders, metallographic and x-ray-diffraction studies, and measurements of physical and mechanical properties. (B.O.G.)

24004 (NP-tr-638) THEORY OF DISLOCATION IN METALS AND ITS APPLICATION. (Teoriya Dislokatsii V Metallakh i Eye Primeneniye). I. A. Oding. A Translation from a publication of the Publishing House of the Academy of Sciences, U.S.S.R., 1959. 155p.

The theory of dislocations in metals is treated and the application of the theory to solution of metallurgical problems discussed. The application is particularly successful in the case of strength and plasticity of metals and is extended to analysis of structural changes and phase transformations. (D.L.C.)

24005 (NP-tr-663) INVESTIGATION OF THE VISCOSITY OF SOME LIQUIDS IN A WIDE RANGE OF TEMPERATURES. N. I. Kopylov. Translated from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 3: No. 11, 97-101(Nov. 1960). 7p.

Results are presented of the experimental investigation of the relation between the temperature and viscosity of methyl alcohol, n-propyl alcohol, and CCl_4. A capillary viscosimeter of the circular type was used for measuring viscosity. The measurements were made at 20 to 240°C. By means of an empirical formula the viscosity values of the liquids were calculated for temperature values taken over equal intervals. Data obtained in the study are tabulated. (auth)

24006 (NP-tr-666) SOME PROBLEMS OF GREAT PLASTIC DEFORMATION IN METALS UNDER HIGH PRESSURES. B. I. Beresnev, L. F. Vereshchagin, Yu. N. Ryabinin, and L. D. Livshits. Translated from a Publication of the Publishing House of the Academy of Sciences, Moscow, 1960. 93p.

A review of results of research on plastic deformations of metals under high pressures is presented. Of particular interest are changes in the crystalline lattice which take place as a result of the approximation of atoms under the action of external pressure. A detailed study of metal extrusion of 10,000 kg/cm² is described. (J.R.D.)

24007 (NP-tr-686) DIFFUSION PROCESSES IN ALLOYS. (Protsessy Diffuzii V Splavakh). L. M. Mirskii (Mirskiy). A. Translation from State Publishing House of Defense Industry, 1959. 214p.

An exhaustive treatise is presented on diffusion processes in alloys. Results are presented for experiments on the effects of C, Al, Ti, W, and Mo on the diffusion rate of Cr in Ni-base heat-resistant alloys and of W, Mo, Nb, Ti, and V on the self diffusion of Fe in Fe–Ni alloys. The effect of the structure of Ni–W alloys on the diffusion rate is discussed. The conclusions of the experiments are given. (D.L.C.)

24008 (SCL-T-368) ELECTRIC AND MAGNETIC BEHAVIOR OF Nb_3Sn IN THE AREA FORMING A TRANSITION TOWARD THE SUPERCONDUCTION. Werner Wiedemann. Translated by Marcel I. Weinreich (Sandia Corp.) from Z. Physik, 151: 307-27(1958). 26p.

Solid-cylinder samples of the intermetallic compound Nb_3Sn were produced under varying conditions, and the transition curves toward the superconduction with regard to magnetic flux and resistance were determined. The so-

called paramagnetic effect during flux measurements in the longitudinal magnetic field with additional electric-current load was obtained. (auth)

24009 THE CRYSTAL STRUCTURE OF HfAl. Lars-Erik Edshammar (Univ. of Stockholm). Acta Chem. Scand., 15: 403-6(1961).

The crystal structure of HfAl is of the B_f (CrB) structure type. The orthorhombic unit cell, space-group Cmcm (No. 63), has the dimensions a = 3.25_3 A, b = 10.83 A and c = 4.28 A. A comparison between HfAl and other B_f structures is given. (auth)

24010 RELATIONSHIPS BETWEEN ELECTRONIC STRUCTURE AND PHYSICAL PROPERTIES IN TRANSITION METALS. G. Airoldi (Laboratori CISE, Segrate, Italy) and M. Asdente. Energia nucleare (Milan), 8: 342-60 (May 1961). (In Italian)

Some physical properties of the transition metals are considered, and the main similarities along the three series are outlined. Theoretical pictures put forward concerning the electronic states and wavefunctions of transition metals are then described, in particular the independent electron models, according to which theoretical calculations are carried out with different approximations, are given. (auth)

24011 TUNGSTEN–COLUMBIUM–TANTALUM ALLOYS, THEIR HIGH-TEMPERATURE PROPERTIES. J. L. Wilson and C. R. McKinsey (Union Carbide Metals Co., Niagara Falls, N. Y.). J. Metals, 13: 494-6(July 1961).

Alloy compositions blanketing the W–Nb–Ta ternary system were screened by means of hardness tests at 2300° to 2900°F and weight gain in oxygen at 2190°F. These tests delineated areas combining high hot-hardness with at least tenfold improvement in oxidation resistance over that of pure metals. (auth)

24012 ELEVATED TEMPERATURE DIFFUSION IN THE SYSTEMS Nb–Pt, Nb–Se, Nb–Zn, Nb–Co, Ni–Ta, and Fe–Mo. R. E. Seebold and L. S. Birks (Naval Research Lab., Washington, D. C.). J. Nuclear Materials, 3: 260-6(Mar.-Apr., 1961). (In English)

An electron probe microanalyzer is used to determine the composition and extent of phases occurring in bimetal diffusion couples at 1100°C. A total of eighteen phases are determined in six binary systems: Nb–Pt, Nb–Se, Nb–Zn, Nb–Co, Ni–Ta, and Fe–Mo. In all cases the phases are stoichiometric and expressible in small whole numbers. The Nb–Se and Nb–Zn systems are somewhat alike in their phase formations in that Nb–Se exhibits Nb–Se, Nb_2Se_3, and Nb–Se_2 while Nb–Zn produces Nb–Zn, Nb_2Zn_3, $NbZn_2$, and $NbZn_3$. Diffusion between Nb and Pt to form Nb_3Pt, NbPt, $NbPt_2$, and $NbPt_3$ seems to preclude prolonged use of platinum thermocouples in contact with niobium at 1100°C. The only phases produced in the Nb–Co system are Nb_3Co_2 and $NbCo_4$. This system also exhibits an extended region containing about 5 weight percent Nb in Co, in agreement with the solubility limit shown in existing phase diagrams. Ni–Ta diffusion produces zones show strong cracking and grain formation. The phases $TaNi_3$, $TaNi_2$, TaNi, and Ta_2Ni_2 comprise the zones, with pure tantalum precipitating in the $TaNi_2$ phase on cooling from 1100°C. Fe–Mo produces only one phase, Mo_2Fe_3. (auth)

24013 OXYGEN ION SELF-DIFFUSION IN URANIUM DIOXIDE. A. B. Auskern and J. Belle (Westinghouse Electric Corp., Pittsburgh). J. Nuclear Materials, 3: 267-76(Mar.-Apr., 1961). (In English)

By means of the isotopic exchange reaction between uranium dioxide powders of normal O^{18} content and carbon dioxide gas enriched in O^{18}, the self-diffusion of oxygen in stoichiometric and non-stoichiometric uranium dioxide is measured. For essentially stoichiometric UO_2, diffusion (D) of oxygen in the temperature range 550 to 780°C can be represented by the equation $D = 1.2 \times 10^3 \exp(-65\,300/RT)$. In nonstoichiometric UO_2, oxygen diffusion rates are increased, and the activation energy is decreased by more than half. The diffusion current carriers are considered to be oxygen ions in interstitial positions. An interstitialcy mechanism for diffusion is suggested. (auth)

24014 URANIUM ION SELF-DIFFUSION IN UO_2. A. B. Auskern and J. Belle (Westinghouse Electric Corp., Pittsburgh). J. Nuclear Materials, 3: 311-19(Mar.-Apr. 1961). (In English)

Diffusion coefficient (D) measurements for uranium (IV) in stoichiometric UO_2 were made by means of the surface activity decrease method. Uranium diffusion in the temperature range 1450 to 1785°C could be represented by the equation $D = 4.3 \times 10^{-4} \exp(-88\,000/RT)$ cm²/sec. (auth)

24015 TRANSFORMATION KINETICS OF A ZIRCONIUM–URANIUM–HYDROGEN ALLOY. J. C. Bokros (General Atomic Div., General Dynamics Corp., San Diego, Calif.). J. Nuclear Materials, 3: 320-6(Mar.-Apr. 1961). (In English)

The kinetics of the eutectoid transformation of a zirconium–uranium–hydrogen system with an atom ratio of 1:0.03:1 was studied. During quenching through the eutectoid temperature, the transformation of the β solid solution, in equilibrium in this alloy at 600°C, to metastable α' occurred above 490°C. The decomposition of α' occurred rapidly above 450°C, being initiated in less than 10 sec and going to completion in about 30 min. Below 450°C, the decomposition rate of α' decreased rapidly. The reverse reaction of α zirconium and zirconium hydride to form β at 600°C was very rapid, being initiated in less than 10 sec and being 50% complete in 100 sec. (auth)

24016 THE THERMOELECTRIC POWER OF MAGNESIUM–CADMIUM ALLOYS. Seiichiro Noguchi (Tokyo Metropolitan Univ.). J. Phys. Soc. Japan, 16: 1145-50(June 1961). (In English)

The thermoelectric power of magnesium–cadmium alloys is measured relative to that of pure copper at temperatures between room temperature and 300°C. The measurements are made over the entire range of composition, and the data are analyzed by a band-model approximation to obtain information about the band structure of the magnesium–cadmium alloys. The thermoelectric power at 300°C as a function of composition has a smooth nature, although the thermoelectric power at room temperature has three maxima and two minima. For compositions corresponding to the ordered phase, anomalies in the thermoelectric power are observed at the transition point. The results indicate that there is no evidence of any extinction or initiation of a band by the alloying. The situation of the Fermi level in A-overlap is discussed. (auth)

24017 CORRELATION AND PREDICTION OF EXPLOSIVE METAL–WATER REACTION TEMPERATURES. Leo F. Epstein (General Electric Company, Pleasanton, Calif.). Nuclear Sci. and Eng., 10: 247-53(July 1961).

The fast, potentially hazardous chemical reaction between a metal and water can occur in a nuclear reactor only above the melting point of the metal, T_m. There is a critical temperature, $\theta > T_m$, at which the process changes over from the slow corrosion-like reaction to one which proceeds with explosive speed and violence. For the alkali

metals, θ is only slightly greater than T_m. The critical temperature θ was experimentally determined for three high melting point metals, Al, Zr, and U, and it is shown that θ is approximately equal to the temperature at which the metal vapor pressure is 0.15 mm for these cases. This relation suggests that the initiation of the violent metal-water reaction for refractory metals may be a vapor phase phenomenon. On the basis of this hypothesis, and the empirical correlations developed, predictions of the value of θ are presented for a number of other metals for which experimental data are not presently available. (auth)

24018 ADIABATIC DEMAGNETIZATION WITH YTTRIUM-RARE EARTH ALLOYS. David T. Nelson and Sam Legvold (Ames Lab., Ames, Iowa). Phys. Rev., 123: 80-4(July 1, 1961). (IS-244)

Alloys of yttrium with 0.3 and 1.0 at.% gadolinium, 1.0 at.% dysprosium, and 0.6 and 1.0 at.% holmium were investigated to determine their usefulness as the working substance for adiabatic demagnetization. In addition, single crystals of 0.6 and 1.0 at.% holmium-yttrium alloys were studied. Those alloys that exhibited paramagnetic susceptibility behavior in the temperature range 1.2 to 4.2°K were demagnetized adiabatically from about 11 kgauss and 1.25°K. The lowest temperature attained was 0.76°K for the single crystal of 1.0 at.% holmium with the magnetic field parallel to the a axis of the hexagonal crystal. Magnetization measurements obtained for the single crystals in the temperature range 1.2 to 4.2°K indicated strong anisotropy with the a axis as the most effective axis of magnetization. Hysteresis was observed in the magnetization of 1.0 at.% holmium single crystal with the a axis parallel to the field. Entropy removal during magnetization was calculated from the magnetization data for the single crystals and found to be only about 15% of that expected if the alloy behaved like an ideal paramagnetic substance. (auth)

24019 NONLINEARITY AND MICROWAVE LOSSES IN CUBIC STRONTIUM-TITANATE. G. Rupprecht, R. O. Bell, and B. B. Silverman (Raytheon Co., Waltham, Mass.). Phys. Rev., 123: 97-98(July 1, 1961).

The complex dielectric constant of single-crystal strontium titanate is measured from 90 to 230°K at microwave frequencies. The real part of the dielectric constant consists of a large field-independent contribution that obeys a Curie-Weiss law over the entire range of measurement, plus a smaller anisotropic field-dependent contribution. These results are shown to be in qualitative agreement with the theory of ferroelectricity in perovskite structures. The observed loss tangent consists of a contribution that is quadratic in an applied biasing field plus a field-independent contribution. The field-independent loss tangent goes through a minimum at about 170° with a much steeper slope on the low-temperature side of the minimum than on the high-temperature side. The behavior of the field-independent loss tangent is discussed. (auth)

24020 X-RAY AND MICROSCOPIC EXAMINATION OF THE ALLOYS OF Hf WITH Re. E. I. Gladyshevskii, M. A. Tylkina, and E. M. Savitskii (L'vov State Univ., USSR and Baikov Inst. of Metallurgy, Academy of Sciences, USSR). Soviet Phys.-Crystallography, 5: 836-40(May-June 1961).

Four compounds were detected in the Hf–Re system. The structures of the two determined, Hf_5Re_{24} and $HfRe_2$, show that the Hf–Re system is analogous to Zr–Re. Rhenium was found to be only very slightly soluble in Hf. The χ and σ phases are formed in all binary systems containing Re and a transition metal of the fourth, fifth, or sixth group. Hafnium forms λ phases with many of the transition elements. Results from powder patterns and interatomic distances for both compounds and lattice constants of the phases in the Hf–Re system are given. (P.C.H.)

24021 INTERNAL FRICTION AND DISLOCATION DENSITY AFTER PRELIMINARY PLASTIC DEFORMATION OF LiF. Yu. Kh. Vekilov, N. A. Tyapunina, and M. P. Shaskol'skaya (Moscow State Univ.). Soviet Phys.-Crystallography, 5: 908-10(May-June 1961).

A comparison is made between internal friction, double-refraction bands, and variation in dislocation density after deformation of LiF single crystals. The object of the preliminary deformation was to increase the dislocation density. Internal friction was measured by the resonance method using a composite quartz oscillator at a frequency of 100 kc. The dislocation density was determined from the number of etch figures. It was concluded that internal friction increases with increased dislocation density. The variation in the value of internal friction is associated with the length of the dislocation loops. This is shown by the recovery of the internal friction observed and by the decrease in internal friction under the influence of x irradiation. (P.C.H.)

24022 SELF-DIFFUSION AND THE STRUCTURE OF MOLTEN SALTS. Arnold Lundén. Trans. Chalmers Univ. Technol., Gothenburg, No. 241, 1-14(1961). (In English)

Self-diffusion data were obtained for molten salts to determine the extent to which plausible results would be obtained based on a test of models proposed for the structure of liquids. The measured self-diffusion coefficients are of the same order of magnitude for all molten salts that have a high electric conductivity. Cation and anion tendencies tend to be equal. The process seems to be insensitive to the size and shape of the ions. For molten salts, reasonable results were obtained in many cases although no particular model seemed to be superior to others. (L.N.N.)

24023 INVESTIGATIONS ON THE MIXING PROCESSES AT LOW TEMPERATURES IN AN ALUMINIUM ALLOY WITH 10 WT.% Mg. Hildegard Cordier and Klaus Detert (Technische Universität, Berlin). Z. Metallk., 52: 321-8(May 1961). (In German)

The electrical resistance of wires consisting of an aluminium-rich alloy with 10 wt.% Mg was measured in the aging temperature range 150 to −35°C. The influence of cooling as well as deformation in extension during aging at room temperature was determined. In the temperature range 50 to −35°C an increase of the specific resistance during aging of 0.6% at room temperature and 2% at −35°C was observed. The linear contraction of the wire amounted to 0.036% during aging at room temperature. Fast quenching in water led to an accelerated change of resistance during aging. The observed effects were interpreted as zoning or phase separation in general coherence with the lattice. The phase separation is mainly due to an increased number of zones. The zone size is a little larger than 10 Å. The kinetics of these processes were explained by an excess of vacancies during phase separation. The acceleration of the process caused by quenching in water is due to place exchange reactions in consequence of the excess of quenched-in vacancies. (auth)

24024 NON-OCTAHEDRAL SLIP IN MULTICRYSTALLINE ALUMINIUM. Randolf J. Hartmann and Eckard Macherauch (Max-Planck-Institut für Metallforschung, Stuttgart). Z. Metallk., 52: 353-8(May 1961). (In German)

It was found by a combination of x-ray, light and electron microscope examinations that nonoctahedral slip occurs relatively often during deformation of polycrystalline aluminum

samples. Almost 30% of the examined aluminum samples with an average crystallite diameter of 0.1 to 0.5 mm showed {100}, {110}, {113} and {133} slip planes. This nonoctahedral slip takes place at deformation rates of less than 2.5%. Observations on crystallites with an average diameter of more than 0.5 mm lead to the conclusion that with increasing grain size the tendency for octahedral slip increases. The observed relative frequency of nonoctahedral planes is closely related to the ratio of Burger's vector and slip plane spacing. (auth)

24025 FATIGUE STRENGTH OF URANIUM WITH 0.35 WT.% Nb. Hans Bühler and Walter Schreiber. Z. Metallk., 52: 365-7(May 1961). (In German)

Torsion fatigue strength tests were carried out with uranium samples containing 0.35 wt.% Nb. S-N curves with damage lines and axial loading diagrams were established. (auth)

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Thirteen papers are included with the discussions that followed their presentation. The topics presented are application of radioelements to the study of metal purification by the "fused zone" method, application of electric resistivity measurements at very low temperatures to the study of metal purification by the fused zone method, physical and chemical properties of fused zone aluminum, study by electric resistivity measurements at low temperature of the elimination of reticular faults in pure aluminum, new physical, mechanical, and magnetic properties of fused zone iron, study of the polygonization of fused zone iron, polygonization of fused zone aluminum, techniques and results of fused zone purification of titanium and iron, vertical fused zone purification of copper, perfecting the fused zone method, improvement in floating zone techniques, floating fuzed zone method, and the structure of the oxidation interface of iron. (J.S.R.)

24027 DEVELOPMENT OF ZIRCALOY-4. J. N. Chirigos, S. Kass, W. W. Kirk, G. J. Salvaggio (Westinghouse Electric Corp., Pittsburgh). p.19-55 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

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24028 TRANSFORMATION CHARACTERISTICS OF A ZIRCONIUM-15% NIOBIUM ALLOY. D. Quataert (Centre d'Etudes de l'Energie Nucléaire, Mol, Belg.). p.111-19 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

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24029 INVESTIGATION OF SOME ALUMINIUM ALLOYS AS CLADDING MATERIALS IN WATER-COOLED REACTORS FOR DISTRICT HEATING AND PROCESS STEAM GENERATION. K. Hannerz, R. Lindblad, and A. W. Magnusson (ASEA, Västerås, Sweden). p.121-44 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

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24030 SINTER ALUMINIUM AS CLADDING MATERIAL FOR FUEL ELEMENTS. K. E. Mann and M. B. Boudouresques (Otto Fuchs, Meinerzhagen, Westfalen, Ger. and Centre d'Etudes Nucléaires, Saclay, France). p.145-56 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

The following topics are discussed: survey of the production process of sinter aluminum; the forming processes (extrusion, forging, and rolling); the production of tubing

for atom piles; production of ribbed tubes and tubes with close tolerances of sizes; the different SAP-qualities and their properties under special consideration of the properties at elevated temperatures and the creep properties; diffusion behavior of SAP with Be, Mg, Al, U, and UO_2; corrosion behavior in CO_2 atmosphere at high temperature and in water; weldability; effect of irradiation on the mechanical properties; and superiority of SAP compared with normal wrought alloys of the same composition. (auth)

24031 MATERIALS RESEARCH ON CLADDING FOR A GAS-COOLED FUEL ELEMENT. D. A. Douglas, Jr. (Oak Ridge National Lab., Tenn.). p.157-78 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

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24032 REACTOR GRAPHITE OF LOW PERMEABILITY AND OF HIGH DENSITY. K. Lipsdorf, R. Schäfer, G. Spener, and E. Wege (Special Graphites Div., Kropfmühl-Ringsdorff, Bad Godesberg-Mehlem, Ger.). p.179-87 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

The manufacturing and the properties of an impermeable graphite of nuclear purity and of high density is described in detail. Bavarian natural graphite is used as basis raw material, which is purified to nuclear purity by the method as employed by the Kropfmühl AG. It is bonded with special binders, molded and subsequently heated at a temperature of more than 1200°C. This graphite has a density of about 2.0 g/cm^3 and it has a primary permeability of about 10^{-3} cm^2/sec. This graphite can be brought to a permeability of 10^{-7} cm^2/sec by a simple and economical procedure. The strength and the other mechanical properties of the new graphite grade supersede the known values of customary natural graphites, so that the application of the new grade is also possible under very difficult conditions. In consequence of the high density the rate of oxidation is small and the thermal and electrical properties are favorable, so that this graphite is extensively suited as a cladding (canning) for fuel elements especially employed in high temperature reactors. The density and the permeability of the natural graphite grade are far better in comparison to the electrographite of nuclear purity. For the time being, a manufacturing of any shape in small and medium sizes will be possible. Possibilities relating to further development will be discussed. (auth)

24033 THE DEVELOPMENT OF FINE-GRAIN GRAPHITES WITH LOW PERMEABILITY TO GASES. E. Fitzer, K. W. F. Etzel, A. Pelz, and O. Vohler (Siemens-Planiawerke A. G., Meitingen, Ger. and Farbwerke Hoechst A. G., Frankfurt am Main). p.189-202 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

The development of extremely fine-grain artificial graphite-types and the possibilities of rendering them impermeable for gases are discussed. Diagrams and microphotographs are shown. Furthermore, the testing methods for such materials will be dealt with more closely. (auth)

24034 CLADDING FOR ORGANIC AND SODIUM REACTOR FUEL ELEMENTS. H. Pearlman (Atomics International, Canoga Park, Calif.). p.203-35 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

Type 304 austenitic (18–8) stainless steel cladding is successfully used in fuel elements for the Organic Moderated Reactor Experiment. These elements are of plate configuration, with a fueled portion consisting of UO_2 dispersed in stainless steel, clad with 5 mils (0.013 cm) of the same steel. Bulk temperature of the mixed polyphenyl coolant is near 620°F, and peak temperature on the cladding–coolant interface is near 750°F. For use in the organic power reactor plant at Piqua, Ohio, type 1100 aluminum cladding is chosen. The Piqua elements are of nested tubular cross-section, consisting of a uranium alloy fueled portion of weight-per cent composition 96.4U–3.5Mo–0.1Al, metallurgically bonded through a thin layer of nickel to the aluminum cladding. The tubular cladding has an extended surface in the form of raised fins, extruded with a twist to produce a helical finned configuration. Magnesium, zirconium and zirconium alloys are not satisfactory for use in organics. Advanced organic reactor designs utilizing UO_2 fuel employ cladding made of an aluminum oxide–aluminum cermet material. Projected operating conditions include a peak temperature of 850°F at the cladding–coolant interface. Mechanical and physical properties of APM type M257 (which consists nominally of $95Al-5Al_2O_3$), and compatibility both with UO_2 and with polyphenyls are adequate for such service. Fabrication of helical finned tubing by extrusion, joining by flash welding and tube closures by several means are accomplished. Type 304 stainless steel tubular cladding is used satisfactorily in the Sodium Reactor Experiment. Normal cladding surface temperature has not exceeded 1100°F. For advanced sodium reactor designs, zirconium alloy cladding shows good promise, based on fabricability, low neutron absorption, excellent compatibility with the reactor environment and favorable mechanical properties at temperatures near 1200°F. (auth)

24035 PRODUCTION AND PROPERTIES OF ZIRCONIUM AND ZIRCONIUM ALLOYS. L. Bangert (W. C.

samples. Almost 30% of the examined aluminum samples with an average crystallite diameter of 0.1 to 0.5 mm showed {100}, {110}, {113} and {133} slip planes. This nonoctahedral slip takes place at deformation rates of less than 2.5%. Observations on crystallites with an average diameter of more than 0.5 mm lead to the conclusion that with increasing grain size the tendency for octahedral slip increases. The observed relative frequency of nonoctahedral planes is closely related to the ratio of Burger's vector and slip plane spacing. (auth)

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The development of extremely fine-grain artificial graphite-types and the possibilities of rendering them impermeable for gases are discussed. Diagrams and microphotographs are shown. Furthermore, the testing methods for such materials will be dealt with more closely. (auth)

24034 CLADDING FOR ORGANIC AND SODIUM REACTOR FUEL ELEMENTS. H. Pearlman (Atomics International, Canoga Park, Calif.). p.203-35 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

Type 304 austenitic (18–8) stainless steel cladding is successfully used in fuel elements for the Organic Moderated Reactor Experiment. These elements are of plate configuration, with a fueled portion consisting of UO_2 dispersed in stainless steel, clad with 5 mils (0.013 cm) of the same steel. Bulk temperature of the mixed polyphenyl coolant is near 620°F, and peak temperature on the cladding–coolant interface is near 750°F. For use in the organic power reactor plant at Piqua, Ohio, type 1100 aluminum cladding is chosen. The Piqua elements are of nested tubular cross-section, consisting of a uranium alloy fueled portion of weight-per cent composition 96.4U–3.5Mo–0.1Al, metallurgically bonded through a thin layer of nickel to the aluminum cladding. The tubular cladding has an extended surface in the form of raised fins, extruded with a twist to produce a helical finned configuration. Magnesium, zirconium and zirconium alloys are not satisfactory for use in organics. Advanced organic reactor designs utilizing UO_2 fuel employ cladding made of an aluminum oxide–aluminum cermet material. Projected operating conditions include a peak temperature of 850°F at the cladding–coolant interface. Mechanical and physical properties of APM type M257 (which consists nominally of 95Al–5Al_2O_3), and compatibility both with UO_2 and with polyphenyls are adequate for such service. Fabrication of helical finned tubing by extrusion, joining by flash welding and tube closures by several means are accomplished. Type 304 stainless steel tubular cladding is used satisfactorily in the Sodium Reactor Experiment. Normal cladding surface temperature has not exceeded 1100°F. For advanced sodium reactor designs, zirconium alloy cladding shows good promise, based on fabricability, low neutron absorption, excellent compatibility with the reactor environment and favorable mechanical properties at temperatures near 1200°F. (auth)

24035 PRODUCTION AND PROPERTIES OF ZIRCONIUM AND ZIRCONIUM ALLOYS. L. Bangert (W. C.

Heraeus G.m.b.H., Hanau am Main, Ger.). p.251-70 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

A survey is given on the zirconium alloys which are actually in use or in state of development for reactor purposes. In the first range alloys made on basis of Zr–Sn and Zr–Nb are discussed. The corrosion resistance, the mechanical and physical properties are compared. The fabrication of semi-products and finished structural parts made from zirconium and its alloys beginning with the melting and alloying technique of the pure reactor grade sponge is described. A survey is given on the vacuum furnaces suitable for melting of zirconium under special consideration of the vacuum arc furnaces and high-vacuum electron beam furnaces. Subsequently the terms of acceptance tests, especially for the canning tubes, are discussed in comparison to the certified test reports as requested by the different countries. Furthermore a summary is given of the facilities with regard to the fabrication of semi-products made of zirconium and its alloys. As to the finished structural parts, these are discussed by examples, for instance by demonstrating pressure tubes, the facilities of joining, i.e., screwing, welding and brazing, particularly with respect to the corrosion resistance of these joints in water or steam at high temperature. Finally the fabrication costs and questions of economy are dealt with. (auth)

24036 INCORPORATION OF FUEL INTO GAS-COOLED HIGH-TEMPERATURE FUEL ELEMENTS. A. Boettcher, W. Krummeich, and G. Wirths (Degussa, Frankfurt am Main). p.373-7 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

For a gas-cooled high-temperature reactor, ball-shaped graphite fuel elements with enriched uranium (20% U_{235}) are envisaged. There is chosen a heterogeneous solution, where a cylindrical fuel pellet is put into a prepared boring of a sphere of nuclear pure graphite, and where this boring is subsequently closed by a thread plug. Even at the highest conceivable temperatures it does not chemically react with the surrounding material; it has a good thermal conductivity, similar to that of graphite; its thermal expansion ensures a good thermal contact with the boring wall. Finally its mechanical and chemical stability allows simple handling. These conditions are met by a body, consisting of a mixture of graphite and uranium–dicarbide (UC_2) where the atomic relation between uranium and carbon lies in the vicinity of 1:45. Such a fuel pellet is produced by heating a pressed body of uranium–oxide and natural graphite in vacuo to approximately 2000°C. (auth)

24037 UNIQUE FABRICATION PROCESSES APPLIED TO FUEL CLADDING MATERIALS. S. H. Bush (General Electric Co., Richland, Wash.). p.379-90 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

Various fabrication operations are described as applied to such fuel element cladding materials as zirconium, aluminum, and stainless steels. Included are the following: controlled plug and die sizing with metal and plastic dies; forming of internal, external, and internal and external ribs or tubes by swaging; controlled sinking and tapering by swaging; deep forming of element hardware; the vacuum precision casting of various types of fuel element hardware such as end caps and supports; special closure methods including swaging, extrusion closure utilizing the Dynapak, projection welding, electron beam welding, seam welding, and magnetic force welding; the attachment of supports by resistance spot and ultrasonic welding; precision forming of irregular shapes by spark machining. Particular emphasis is given to the fabrication of Zircaloy-2; however, the application of many of these techniques to both aluminum alloys and the stainless steels is also described. Descriptions of the fabrication operations include the design of dies used, selection of die materials, lubricants, forming conditions, and results attained. In those instances where the fabrication process might adversely affect the properties of the cladding by contamination, excessive cold work or generation of internal or surface defects, the properties of the cladding material are also described. The work described is limited to operations on the cladding material and no consideration is given to the behavior of the fuel. Performance of cladding, where considered, was determined on the basis of ex-reactor tests. (auth)

24038 SOME PROPERTIES OF NICKEL CONTAINING A DISPERSED PHASE OF THORIA. D. K. Worn and S. F. Marton (Mond Nickel Co., Birmingham, Eng.). p.309-42 of "Powder Metallurgy." Werner Leszynski, ed. New York, Academic Press, 1961.

The hardening of nickel by highly dispersed inert phases is described. Preparation by two methods is described—mechanical mixing of fine nickel and thoria powders, followed by compaction and extrusion; and mixing of nickel oxide with thorium nitrate solution, followed by ignition, reduction, compaction, and extrusion. The important characteristics of the raw materials used are considered. Data are presented correlating room temperature mechanical properties and elevated temperature stress-rupture properties, with the characteristics of the oxide dispersion. The work-hardening and recrystallization behavior of cold drawn nickel-thoria alloys is described and discussed in relation to the alloy structure. Experiments on the effect of aging at temperatures up to 1400°C of the dispersion are reported. It is shown that in the absence of harmful impurities, the nickel-thoria system displays a very high degree of stability of temperatures up to 1200°C, but under certain conditions marked agglomeration of the oxide phase occurs. (auth)

24039 RECENT INVESTIGATIONS OF HIGH TEMPERATURE ALLOYS OF MOLYBDENUM AND TUNGSTEN WITH TRANSITION METALS OF GROUPS IVa TO VIIa OF THE PERIODIC TABLE. Horst Braun and Karl Sedlatschek (Metallwerk Plansee A.G., Reutte/Tyrol, Austria). p.645-50 of "Powder Metallurgy." Werner Leszynski, ed. New York, Academic Press, 1961.

The workability of sintered and arc-melted tungsten-niobium and tungsten-tantalum alloys are examined as well as the following properties of alloys with compositions across the entire binary systems: density, hardness at room and elevated temperatures, specific electric resistivity, thermoelectric force, hydridability, and corrosion resistance against acids and alkali. Alloys of molybdenum with 0 to 100% niobium and tantalum are technologically surveyed; their density, hardness, specific electrical resistivity, thermoelectric force, and corrosion resistance are examined and their workability evaluated. Sintered alloys of tungsten with up to 30% rhenium are examined in the cold- or hot-rolled condition; their strength, ductility, recrystallization behavior, and thermoelectric force against tungsten are evaluated. The tungsten-vanadium and tungsten-hafnium systems are examined metallographically and by x-ray means and their constitutional diagrams established. (auth)

24040 TITANIUM AND ZIRCONIUM POWDER METALLURGY. A. D. Schwope (Clevite Corp., Cleveland). p.731-

46 of "Powder Metallurgy." Werner Leszynski, ed. New York, Academic Press, 1961.

The application of powder metallurgy techniques to the manufacture of titanium and zirconium base alloy components offers a potentially economical method of fabrication. Good material utilization coupled with a minimum amount of machining and working are particularly important in the reactive metals. The effect of processing variables on the mechanical and physical properties are described. If a double pressing and sintering operation is used, properties comparable to those found in melted and wrought alloys can be obtained. Strengthening effects at high temperatures of dispersed phases and fibers are reviewed. Present and potential applications of powder products are described. (auth)

24041 THE POWDER METALLURGY OF BERYLLIUM. Wallace W. Beaver and Harold F. Larson (Brush Beryllium Co., Cleveland). p.747-73 of "Powder Metallurgy." Werner Leszynski, ed. New York, Academic Press, 1961.

Fabrication, production, and properties of beryllium powders are described and discussed. Practically all processing methods applicable to powder metallurgy are useful in the consolidation of beryllium powder. Although vacuum hot pressing has many advantages for the production of large- and short-run parts and the ability to cycle machine shop scrap directly back through the attritioning process makes it economic, other conventional powder metallurgy methods as well as specialized techniques can be used for making shapes closer to dimensions and to contour. Mechanical deforming of powder or compacts in containers can be and is also employed. The properties of beryllium metal and the sintering of beryllium powder are dependent principally on the variables such as particle size, shape, and amount and distribution of impurities. It is shown that pressure overcomes many of the powder variables during fabrication. (N.W.R.)

24042 HIGH TEMPERATURE METALLOGRAPHY. M. G. Lozinskii. Translated by L. Herdan. New York, Pergamon Press, 1961. 505p.

The field of high temperature vacuum metallography is discussed. The apparatus, the methods, and the results obtained on the microstructure and properties of metals and alloys heated in a vacuum are described. This book is a translation from the Russian language. (N.W.R.)

24043 OXIDE CERAMICS. Physical Chemistry and Technology. Eugene Ryshkewitch. New York, Academic Press, 1960. 480p.

Production and application of ceramics of single phase oxide systems are described from the standpoint of physical chemistry and of technology. A brief description is also given of two phase systems composed of oxides with metals or with carbides. The ceramic materials described are alumina, spinels, magnesia, beryllia, zirconia, zirconium silicate, thoria, ceria, and oxide-metal and oxide-carbide systems. Emphasis is laid on similarities of physicochemical phenomena, conditions of brittleness of metals and of ductility of oxides, strength improvement, stabilization and destablization, and high temperature properties. (N.W.R.)

24044 NICKEL-BASE ALLOY. (to U. S. Atomic Energy Commission). British Patent 871,120. June 21, 1961.

Preparation and properties of nickel-base alloys having resistance to oxidation and salt corrosion are described. The nickel-base alloy consists of 15 to 22% by weight of molybdenum, 0.02 to 0.5% carbon, 0 to 8% chromium, 0 to 6% iron, and 0 to 4% tungsten, tantalum, vanadium, or niobium, or a mixture of two or more of the elements as an additional strengthening agent, the balance being nickel. (N.W.R.)

Radiation Effects

24045 (AD-250515) NGL PLATFORM NUCLEAR RADIATION PROGRAM. Second Bimonthly Report, July 23–September 23, 1960. (Litton Systems, Inc., Beverly Hills, Calif.). Oct. 10, 1960. Contract AF33 (600)-41452. 34p.

The feasibility of producing a nuclear radiation-resistant No Gimbal Lock (NGL) inertial platform is being investigated. The dynamic testing of materials was carried out in the Convair radiation effects reactor. The various materials were procured, the material test equipment was designed and constructed, and the design for the component test equipment was completed. Analysis of the radiation dosimetry measurements is incomplete. However, it was estimated that the fast neutron dose rate to the materials was 2×10^{13} n/cm^2/hr above a neutron energy of 2.9 Mev. Resistors, capacitors, insulating materials, transistors, diodes, lubricants, flotation fluids, temperature probes, pressure transducers, and thermostats were irradiated and tested. (M.C.G.)

24046 (AFOSR-111) EFFECT OF X RAYS COLORING ON ADDITIVELY COLORED ALKALI HALIDES. Technical Note No. 2. G. Bonfiglioli, P. Brovetto, and C. Cortese (Turin. Istituto Elettrotecnico Nazionale Galileo Ferraris). [1960]. Contract AF61(052)-328. 20p. (AD-252837)

The mechanism for thermoluminescence of x-rayed NaCl above room temperature and other alkali halides was investigated. The approach to saturation shown by the curves describing the F center formation under irradiation was considered to see whether the saturation could be caused by the same recombinations which produce thermoluminescence. An experiment was carried out artificially altering the recombination term and comparing the curves of F center formation obtained by irradiating a pure crystal of KI and a KI crystal already containing V centers by stoichiometric excess of I_2. Results of various spectrophotometric measurements performed showed that saturation is obtained much sooner and at a much lower level when excess V centers are present. The value of the recombination term was estimated. (auth)

24047 (ANL-6347) THE PERFORMANCE OF A MOTOR, A SWITCH, AND TWO TYPES OF PRESSURE PICKUP IN A HIGH-GAMMA-FLUX ENVIRONMENT. James E. Ayer and George J. Pokorny (Argonne National Lab., Ill.). June 1961. Contract W-31-109-eng-38. 17p.

To determine the effects of gamma radiation upon transducers, switches, and motors, two test assemblies were irradiated in the ANL Gamma Irradiation Facility at levels of 1.50×10^5 to 2.10×10^6 rad/hr to a total dose of 1.0×10^9 rad. The components tested were a motor, a strain-gage pressure pickup, a quartz pressure pickup, and a high-temperature switch. The performances of the strain-gage pickup and snap switch were highly satisfactory over the test period. The quartz pickup, however, exhibited a sensitivity to radiation which rendered it ineffective for use in such an environment. Radiation damage to the motor was manifest as degradation of insulation, and evaporation and condensation of some of the products of degradation upon the walls of the test containment shell. As a result, the motor lost power, indicating a need for insulation more resistant to gamma radiation. Radiation damage to paints, varnish, grease, and conventional insu-

lations was noted, but the extent of this effect was not considered detrimental to the test. (auth)

24048 (BMI-1521) EFFECTS OF RADIATION UPON HAFNIUM DIBORIDE. Robert A. Ewing and Duane N. Sunderman (Battelle Memorial Inst., Columbus, Ohio). June 14, 1961. Contract W-7405-eng-92. 10p.

Natural hafnium diboride and hafnium diboride 55% enriched in boron-10 were irradiated in the ETR to boron-10 burnups of about 25 to 50% from 400 to 600°F. Major structural damage was revealed by x-ray diffraction examination, both diborides degrading to amorphous structures. Attempts to measure helium retention were unsuccessful. On the basis of the results, neither the natural nor the enriched compound seems to offer much promise for control-rod applications. (auth)

24049 (BNL-5453) THE FARADAY SOCIETY DISCUSSION ON RADIATION EFFECTS IN INORGANIC SOLIDS, APRIL 11 AND 12, 1961. GENERAL INTRODUCTION. George H. Vineyard (Brookhaven National Lab., Upton, N. Y.). [1961?]. 42p.

Lattice defects are produced by radiation through interaction with electrons and with atoms. Current ideas of these effects are reviewed, and some recent direct calculations of radiation damage events are presented. Arguments are given for believing that clusters of point defects, particularly vacancies, are a prominent component of damage produced by bombardment with energetic heavy particles. Some recent calculations of the stability of clusters of three and four vacancies in copper are described. A numerical illustration of a thermal spike is discussed. Current theories of the production of defects in insulators by ionizing radiation are also reviewed. (auth)

24050 (CRGM-1015) THE EFFECT OF NEUTRON IRRADIATION, HYDRIDE PRECIPITATE AND HYDRIDE LAYERS ON THE IMPACT PROPERTIES OF ZIRCALOY-2. L. M. Howe (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 1961. 40p. (AECL-1239)

Sub-size impact specimens of annealed and cold-worked Zircaloy-2 were irradiated at 220°C with 3.6×10^{19} n/cm^2, at 280°C with 2.7×10^{20} n/cm^2, and then tested. It was found that the irradiation had very little effect on the impact properties of either the cold-worked or the annealed material. Results are given on the effect of a hydride precipitate on the impact properties of unirradiated material. Hydride layers ~10 μm thick were deposited electrolytically on annealed Zircaloy-2 impact specimens. The presence of the hydride layer did not effect the impact properties. Drop weight tests were performed on specimens taken from annealed Zircaloy-2 plate. Catastrophic crack propagation occurred below –115°C for specimens containing 7-ppm hydrogen and below –80°C for those containing 30-ppm hydrogen. (auth)

24051 (CRGM-1022) THE EFFECT OF OXIDE CONTENT ON THE BEHAVIOUR OF HELIUM IN BERYLLIUM. C. E. Ells (Atomic Energy of Canada Ltd., Chalk River, Ont.). May 1961. 14p. (AECL-1253)

A study was made to determine the effect of oxide content in beryllium on the behavior of helium in the metal. The materials investigated had oxide contents from 0.1 to 2.22 wt % and He concentrations in the range 0.3 to 0.7 cm^3 gas/cm^3 metal. The He was introduced by cyclotron α particle irradiation. The growth of He-filled bubbles was studied by metallographic techniques. No marked dependence of the amount of bubble growth on oxide content was observed, particularly for the materials containing ≥0.25 wt % oxide. It appears that any tendency for oxide to increase bubble growth is already saturated at 0.25 wt %. (auth)

24052 (HW-SA-2201) EFFECT OF TEMPERATURE ON RADIATION-INDUCED CONTRACTION OF REACTOR GRAPHITE. J. M. Davidson and J. W. Helm (General Electric Co. Hanford Products Operation, Richland, Wash.). May 31, 1961. Contract AT(45-1)-1350. 12p.

The distortion behavior of graphite as a function of irradiation temperature is reviewed. The behavior of needle-coke and CSF graphite was examined over moderate exposures in the GETR. Results showed needle-coke to be less contracting than CSF. Details of contraction show a minimum contraction rate per 10^{21} nvt at 600 to 800°C for both types. Limitations to be placed on the data presented are listed. (P.C.H.)

24053 (HW-SA-2219) VOIDS IN IRRADIATED UO_2. J. Lambert Bates (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 1960. 18p.

Five types of voids which were observed during the metallographic examination of cylindrical UO_2 fuel elements irradiated under conditions that produce high central core temperatures and large radial temperature gradients are described. Possible relationships between the types of voids and the microstructural changes in UO_2 which occur during irradiation are discussed. The structural changes in irradiated UO_2 fuel cores, in order of occurrence from the cladding to the thermal center of the core are: non-sintered UO_2, sintered UO_2 and equiaxed grains of UO_2, small columnar grains of UO_2, large columnar grains of UO_2, and macroscopic central void. The types of voids related to these various microstructures are: irregular voids; plate-like voids; tubular, spherical, and irregular voids; macroscopic central void, and large spherical voids. (M.C.G.)

24054 (NP-9483) RADIATION EFFECTS IN IONIC CRYSTALS. S. Amelinckx (Brussels. Centre d'Étude de l'Énergie Nucléaire). 151p. 1960.

A review of radiation effects in ionic crystals is presented. Included is information obtained in studies of optical properties, paramagnetic resonance, and production of color centers. Effects of irradiation on geometrical, mechanical, and transport properties are also examined. (J.R.D.)

24055 (NP-9571) PRELIMINARY DATA FROM NUCLEAR RADIATION TESTS OF THE PS-210 POWER SUPPLY. W. E. Spencer and H. B. Almond (Boeing Airplane Co., Seattle). Sept. 3, 1959. 12p. ([BOE]-5-7870-7739)

A transistorized voltage regulated power supply with a three-phase 115/208 volt 400 cycle input and a 150 volt d-c output was irradiated using a pulsed critical assembly. Transient and permanent damage measurements were made with the power supply operating during four radiation bursts yielding a total of about 9×10^{12} fast neutrons/cm^2. The transient and permanent effects were minor during the first three bursts with a total of 4.4×10^{12} neutrons/cm^2. During the last burst (4.9×10^{12} nvt) the output voltage shifted to 148 volts and the ripple rose to 560 mv. A permanent damage effect was noted which resulted in the drop out of regulation of the power supply when subjected to maximum load. (auth)

24056 (NP-10352) EFFECT OF GAMMA RADIATION FROM COBALT 60 ON THE MECHANICAL PROPERTIES OF SOLID PROPELLANTS ALL AND CDT. Y. K. Roots and T. D. Phillips (Naval Propellant Plant, Indian Head, Md.). June 2, 1960. 8p. (TMR-179)

Specimens of the double-base propellant ALL and the hybrid CDT were subjected to irradiation in the Co^{60}

source. After conditioning at 77°F for 24 hours, mechanical-properties tests were applied to determine the damage. The results are similar to those obtained with the other propellants: a marked deterioration in mechanical properties (i.e., nominal tensile strength, elongation, and work to produce maximum stress). (auth)

24057 (NP-10397) RADIATION EFFECTS ON Al_2O_3–Al_2O_3MgO–MgO. (Strahlenwirkungen auf Al_2O_3–Al_2O_3MgO–MgO). Oskar Liskowsky (Kernforschungsanlage, Jülich, Germany). Apr. 1961. 7p.

References (38) to handbooks, reports, and U.S. and foreign journals from 1948 to 1960 are included. For convenience in abstract scanning, CA and NSA abstract numbers are given when possible. (P.C.H.)

24058 (NP-10398) RADIATION EFFECTS ON CaF_2. (Strahlenwirkungen auf CaF_2). Mary Wittenberg (Kernforschungs-anlage, Jülich, Germany). Apr. 1961. 4p.

References (24) are given to U. S. and foreign journal items, reports, and abstract journals for the period 1921 to 1961. NSA abstract numbers are given when available. (P.C.H.)

24059 (NP-10399) RADIATION DAMAGE IN INORGANIC GLASSES. BIBLIOGRAPHY 1910–1959. (Strahlenschäden bei Anorganischen Gläsern). Oskar Liskowsky (Kernforschungsanlage, Jülich, Germany). 18p.

References are given to reports, U.S. and foreign journals, and conference papers published from 1910 to 1959. For convenience in abstract scanning, CA and NSA abstract numbers are given when possible. (P.C.H.)

24060 (TID-7610(p.104-12)) THE DIMENSIONAL STABILITY OF IRRADIATION OF Al_2O_3–UO_2, BeO–UO_2, GRAPHITE–UC, AND GRAPHITE–UC_2. Dale E. Johnson and J. Martin Tobin (General Atomic Div., General Dynamics Corp., San Diego, Calif.).

Irradiation of several diluted fuel materials was performed in support of the Maritime Gas Cooled Reactor Project. Post-irradiation measurements included dimensional determinations of the fuel cladding, density determinations of the clad specimens, dimensional measurements of the individual fuel pellets, collection and analysis of the fission gas that had accumulated in the several claddings, and metallographic studies of the fuel pellets. The Al_2O_3–20 vol % UO_2 fuel was irradiated to about 4×10^{19} fissions/cm^3 of fuel pellet with no apparent damage in the fuel integrity and less than 1% damage in pellet dimensions. The BeO–20 vol % UO_2 system was irradiated to about 2×10^{20} fissions/cm^3 of fuel pellet with no breakage and less than 1% damage in pellet dimension. The graphite–20 vol % UC and the graphite–20 vol % UC_2 fuels were irradiated to about 6×10^{19} fissions/cm^3 of fuel pellet with less than 1% change in dimensions. The two graphite based fuels with 30% enriched uranium were irradiated to 2×10^{20} fissions/cm^3 of fuel pellet with no measureable change in fuel cladding dimensions. (M.C.G.)

24061 (AEC-tr-4739) THE PRECIPITATION OF LITHIUM IN SINGLE CRYSTALS OF LITHIUM FLUORIDE IRRADIATED WITH THERMAL NEUTRONS. M. Lambert, C. Mazieres, and A. Guinier. Translated by Gordon R. Love (Carnegie Inst. of Tech.) from J. Phys. Chem. Solids, 18: 129-38(1961). 20p.

A study of the formation and transformation of Li precipitates formed due to irradiation is discussed. X-ray results are given and compared with data obtained from differential thermal microanalysis. The form of the magnetic resonance peak indicates the thickness of the Li platelets after treatment at 700° to be on the order of 1μ. Using x rays it was verified that metallic Li was precipitated, but only in the bcc form. (P.C.H.)

24062 EFFECT OF γ^{60}Co RADIATION ON THE DIELECTRIC PROPERTIES OF TRIGLYCINE SULPHATE. B. Hilczer (Inst. of Physics, Polish Academy of Sciences [Warsaw]). Bull. acad. polon. sci. Sér. sci., math., astron. et phys., 9: 229-34(1961). (In English)

Changes are produced in the ferroelectric properties and in the shape of the dielectric hysteresis loop. The effects on the ferroelectric properties are similar to those produced by UV, x rays, and electrons. There is a decrease in the dielectric permittivity between 30 and 70°C, and small variations in the shape of the hysteresis loop are produced. Constriction of the loop due to x-ray and electron (up to 1 Mev) irradiations is also reported. (L.N.N.)

24063 THE EFFECTS OF RADIATION ON THE TANTALUM–TANTALUM OXIDE ELECTRODE. F. S. Feates and B. Knight (AERE, Harwell, Berks, Eng.). J. Nuclear Materials, 3: 277-83(Mar.-Apr., 1961). (In English)

The Ta/Ta_2O_5 electrolyte system is studied after irradiation with γ rays or electrons. The results are compared with those for irradiation with UV and x-rays. Photocurrents are measured that are proportional to radiation intensity at low dose rates. At high dose rates the rate of increase of photocurrent becomes smaller. No significant increase in the thickness of the oxide is measured after irradiation. Tantalum foil electrolytic capacitors are convenient for making rapid routine measurements of photoeffects. (auth)

24064 STUDY OF DISORDERING BY IRRADIATION OF U_2Mo. J. Bloch, J. Doulat, and J. Blin (Commissariat à l'Énergie Atomique, Gif-sur-Yvette, France). J. Nuclear Materials, 3: 327-30(Mar.-Apr. 1961). (In French)

U-Mo alloys having the composition of U_2Mo, a compound with an ordered tetragonal structure, were irradiated. Two series of irradiation experiments were carried out, one in the EL 2 reactor at temperatures between 20 and 65°C and the other in the "Melusine" reactor at the liquid nitrogen temperature. Crystallographic analysis of the samples at various stages of irradiation showed that the transformation from the γ' phase tetragonal structure to the γ phase cubic structure was a continuous function of the burn-up. It was also shown that collisions were mainly responsible for disordering this alloy and that there were about 300 000 collisions per fission. (auth)

24065 MAGNETIC COUPLING HYSTERESIS EFFECT OF DIFFUSION OF FAULTS IN IRON AND NICKEL IRRADIATED WITH NEUTRONS. P. Moser, D. Dautreppe, and P. Brissonneau. J. phys. radium, 22: 37S-38S(Apr. 1961). (In French)

Magnetic coupling hysteresis effect was used to study the faults created by neutron irradiation in iron and nickel. Rings of the metals were irradiated at 20 to 30°C and at 78°C in the Melusine Reactor. No coupling hysteresis band was detected in Ni at either of the irradiation temperatures. In iron, a very sharp hysteresis band appeared after irradiation at 20 to 30°C. The energy of activation of the faults was found to be 1.2 ± 0.1 ev. In irradiation at 78°C a very sharp band followed by a weaker band was detected. The activation energies were 0.3 ± 0.05 and 0.6 ev, respectively. After an anneal of 31 hr at 104°K, the 0.3 band was displaced toward higher temperatures. The same result was observed for the 1.2-ev band. The interpretation of these experimental results was difficult. (J.S.R.)

24066 ORIENTATION SUPERSTRUCTURE CREATED BY NEUTRON IRRADIATION IN AN IRON–NICKEL ALLOY AT

50%. J. Paulevé and D. Dautreppe. J. phys. radium, 22: 39S(Apr. 1961). (In French)

Fe–Ni alloy samples irradiated in the Melusine Reactor under a magnetic field sufficient to saturate them display a uniaxial anisotropy caused by the establishment of an orientation superstructure. This anisotropy attains much higher values than that attained in classical treatments. After irradiation the induced anisotropy continues to evolve at a measurable speed even at room temperature. The evolution is sensitive to the presence of a magnetic field. The variation of the anisotropy energy following anneals at 200 and 250° is graphed. (J.S.R.)

24067 EFFECT OF γ-IRRADIATION ON THE INITIAL PERMEABILITY OF SOME FERROMAGNETICS. E. Trinkler. Latvijas PSR Zinātnu Akad. Vēstis, No. 2(163), 95-8 (1961).

Nickel-zinc ferrite Φ-1000 (66.4% Fe_2O_3, 23.3% ZnO, 10.3% NiO), manganese-zinc ferrite ΦM-2000 (70.8% Fe_2O_3, 10.2% ZnO, 19% MnO), and Permaloy 79 MH were irradiated with a cobalt source, and the initial magnetic permeability was μ measured in the region of weak fields at a frequency of 400 cps. After a total dose of 10^9 r (465 hrs of noncontinuous irradiation at room temperature) the specimens showed no change in either magnitude or the rate of magnetic polarity reversal. With irradiation at −195.8°C, a 15 to 20% drop in the value of μ and an appreciable drop in the value of magnetic polarity reversal rate were observed. Upon return to room temperature, however, both parameters recovered their initial values. In control experiments at −195.8°C without irradiation, the drop in the value of μ was only about 5%. It was concluded that γ-irradiation of ferrite specimens accelerates the process of magnetic disorientation and increases the drop with time of the initial magnetic permeability of ferrites, and heating of irradiated specimens to room temperature is similar to annealing in that the irradiation effect is completely neutralized. (OTS)

24068 ON RECOMBINATION PROCESSES IN NEUTRON-IRRADIATED n-TYPE GERMANIUM. M. Bertolotti and D. Sette (Università, Messina, Italy). Nuovo cimento (10), 20: 438-42(May 1, 1961). (In English)

A calculation of minority charge carrier lifetimes in neutron irradiated n-type germanium is performed, taking into account the presence of damage regions produced by fast secondaries. The results are compared with experimental data. (auth)

24069 ON THE NATURE OF RADIATION DAMAGE DUE TO FAST NEUTRON BOMBARDMENT IN FERROMAGNETIC MATERIALS: VERY HIGH PERMEABILITY PURE IRON AND NICKEL. G. Biorci, A. Ferro, and G. Montalenti (C.N.R., Turin). Nuovo cimento (10), 20: 617-37(May 16, 1961). (In English)

The effects of fast neutron irradiation with doses of 10^{18} nvt on permeability, coercive force, and approach to saturation of very high permeability pure iron and nickel were studied. No significant changes were noted on nickel (maximum permeability 5000). On iron (maximum permeability about 150000, H_c 2.5 A/m) coercive force increased by about 0.8 A/m, maximum permeability decreased by about 30%, and no change was noted in the curve of approach to saturation and hence in the anisotropy energy. After annealing the irradiated iron specimens at 100°C, a further increase of coercive force was observed, and after annealing at 200°C, on one of the specimens a loop with strong wasp-waisted form was noted. Finally, most of the changes in magnetic properties due to irradiation were almost completely recovered below 250°C. The possible theoretical interpretations of the results are discussed. The kinetics of the annealing exclude the possibility that the effects are due to free iron interstitials and probably also to dislocation loops. Hence, it is thought that some type of anisotropic point defects interact with the magnetization vector and move with an activation energy of about 1.2 ev at temperatures of 100 to 200°C. (auth)

24070 LOW-TEMPERATURE RECOVERY OF RESISTIVITY IN ELECTRON-IRRADIATED GOLD. J. B. Ward and J. W. Kauffman (Northwestern Univ., Evanston, Ill.). Phys. Rev., 123: 90-6(July 1, 1961).

The results of two electron irradiations and subsequent isochronal anneals of very pure gold wire, at 13 and 10.5°K, respectively, were described. The anneals were carried out in 1 or 2 degree steps from the lowest temperature up to 65°K, and, in addition, the second set of anneals was extended for 1 hr periods at 125, 170, 225, and 260°K. Each of the anneals produced some recovery. The slope of the isochronal recovery curve showed peaks and indicated a first stage in the annealing, extending up to 45°K, during which 28.5% of the resistivity increment annealed out. From 45 to 65°K no distinct processes were observed. This second stage apparently continued up to 240°K. From 45 to 250°K, 36% of the resistivity increment annealed out; 35.5% remained at this temperature. By assigning a suitable frequency factor K_0 to each process in the first stage and by assuming that the processes are first order (corresponding to recombination of close pairs of vacancies and interstitial), it was possible to calculate the activation energies for each process. For $K_0 = 10^{10}$ to 10^{13} sec^{-1}, these ranged from 0.037 to 0.045 ev for the first peak to 0.11 to 0.13 ev for the fifth. An explanation was proposed for the major differences between the annealing behavior of gold and copper. (auth)

24071 DIRECT OBSERVATIONS OF ION DAMAGE IN CADMIUM. P. B. Price (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev. Letters, 6: 615-17(June 1, 1961).

Negative ions are emitted from electron microscope filaments during normal operation. The effects of these ions on thin Cd films are studied by transmission microscopy techniques, at −100 to +25°C. Dislocation loops are observed, and their temperature dependence is discussed. (T.F.H.)

24072 SEMICONDUCTOR RADIATION DAMAGE IN SPACE. W. L. Brown. (Bell Telephone Labs., Murray Hill, N. J.). [Paper No.] 1755-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 22p.

Energetic electrons and protons trapped in the Van Allen belts limit the lifetimes of semiconductor devices by means of radiation damage. The energy dependence of the damage effect for these two types of particles is qualitatively different but in accord with theoretical expectations. The effects increase with electron energy but decrease with proton energy. The damage effects are sensitive to details of the semiconductor material. The effects depend, for instance, on whether the basic lattice is Ge or Si, or whether a high concentration of oxygen is present in Si. This complexity makes estimation of device performance in a radiation environment less quantitative, although broad comparisons of the effectiveness of different particle types including neutrons and gamma rays can be given. (auth)

24073 THIN BODY TEMPERATURE TRANSIENTS DUE TO GAMMA HEATING IN AEROSPACE. Walter Unterberg (Rocketdyne, North American Aviation, Inc., Canoga Park, Calif.). [Paper No.] 1759-61. Presented at

"Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 26p.

Components of nuclear propulsion and power systems are subject to gamma heating caused by the reactor. These components may be cooled by convection and thermal radiation to the aerospace environment and other parts of the system. Temperature transients in "thin body" components, such as plates, tubes, and shells with small internal temperature and heat generation rate gradients, are evaluated analytically for simple-step and certain time-dependent heating and cooling inputs. For time- and temperature-varying inputs, numerical methods are outlined. Maximum body temperatures, found without solving the basic differential equation, permit shortcuts in design calculations. Thermal radiation is a significant cooling mode. Also discussed are temperature-dependent inputs, and adaptation of the methods presented to extended shapes and complex geometries. (auth)

PHYSICS

General and Miscellaneous

24074 (AD-240502) PAPERS PRESENTED BY RESEARCH LABORATORIES FOR THE ENGINEERING SCIENCES, UNIVERSITY OF VIRGINIA, CHARLOTTESVILLE, VIRGINIA, AT SYMPOSIUM ON ATOMIC AND MOLECULAR GAS BEAMS, DENVER RESEARCH INSTITUTE, UNIVERSITY OF DENVER, COLORADO, JUNE 20-22, 1960. (Virginia. Univ., Charlottesville. Research Labs., for Engineering Sciences). July 1960. 70p.

Four papers presented at the Symposium on Atomic and Molecular Gas Beams are given. The topics covered include molecular beam research, experimental analysis of molecular beams at high source pressures, application of high rotational speed equipment to molecular beam technique, and application of molecular beam techniques to the study of inelastic molecular collision phenomena in gases. (M.C.G.)

24075 (AD-249933) NONLINEAR ELECTRON-WAVE INTERACTION IN CROSSED ELECTRIC AND MAGNETIC FIELDS. TECHNICAL REPORT NO. 39. Om P. Gandhi (Michigan. Univ., Ann Arbor. Research Inst.). Oct. 1960. Contract No. DA-36-039 sc-78260. 263p.

A general two-dimensional large-signal theory was developed for electron-wave interaction in crossed d-c electric and magnetic fields. The six nonlinear integro-differential equations were adapted to study thin- and thick-stream forward- and backward-wave interactions and interactions with multiple streams in crossed fields. The large-signal equations were derived by the self-consistent field method with the space-charge fields evaluated by means of a three-dimensional Green's function in an equivalent rectangular tube, the walls of which coincided with the sole, the anode plane, and the two sole end hats. The error involved in the space-charge field expressions due to replacing the slow-wave structure by a smooth conducting electrode is shown to be negligible. The space-charge fields were simplified to the two-dimensional case in terms of a weighting function dependent upon the ratio of the beam width in the direction of the magnetic field to the spacing between the end hats. The electron stream at the input to the device was divided into a number of layers, each effectively representing approximately 4 to 5% of the interaction region. The large-signal equations were solved on a high-speed digital computer for the electron trajectories, the r-f phase lead, and gain characteristics by following the individual charge elements into which the stream is divided. The effects of magnetic field, space-charge forces, injection velocity parameter, and stream thickness on the interaction were studied for both Brillouin and nonslipping laminar streams. The retention of acceleration terms in the equations of motion was necessary to account for the excitation of cyclotron waves, which are important for cases where $\omega_c/\omega D < 5$. The improvement in phase focusing with the inclusion of space-charge forces resulted in an improvement of the interaction. Gain characteristics for nonlaminar streams are presented for varying degrees of nonlaminarity at the input. The growth factor for thick Brillouin streams is somewhat reduced from that for thin beams due to a wide velocity variation which proved a hindrance to phase focusing. The start-oscillation length of a backward-wave oscillator was determined for varying r-f power levels and found to be shortest for a power level such that there is very little electron collection on the r-f structure. In the double-stream crossed-field interaction, the increased growth parameter was due to the coulomb force between bunches in the two streams, causing the upper bunch to move closer to the circuit and thus enhancing the growth mechanism. The small-signal equations developed for the positive-sole crossed-field interaction indicated the excitation of beating velocity waves on the electron stream under such an interaction. The "complementary behavior" of positive-sole crossed-field interaction with normal (negative-sole) interaction was established on the basis of small-signal equations and some of the results were compared with those obtained from the large-signal equations adapted to the positive-sole case. On the basis of a small-signal premodulation analysis it was found that the drift regions are fairly broadband in phase characteristics. The phase-length characteristics were obtained for maximum growing-wave excitation at the output of these regions. (auth)

24076 (AD-252518) TABULATION OF ATOMIC AND MOLECULAR CHARGE-TRANSFER CROSS SECTIONS. Interim Technical Report No. 1. O. Heinz and E. J. Feinler (Stanford Research Inst., Menlo Park, Calif.). Jan. 20, 1961. Contract DA-04-200-ORD-962. 49p.

Experimental results pertaining to atomic and molecular charge-transfer processes reported in the literature from 1950 through 1960 were collected and tabulated. The parameters listed for each reaction are: the energy interval of the measurement, the maximum charge-transfer cross section, and the energy at which this maximum cross section occurs. Inasmuch as the Massey criterion ($a \Delta E/vh \sim 1$ for maximum σ) still represents the best method for correlating existing data and for making at least rough predictions for other charge-transfer events, calculated values of ΔE were included. A fairly complete bibliography of the charge-transfer literature, including both experimental and theoretical papers, is included. The punched cards from which the tables in this report were printed are available for duplication. (auth)

24077 (AFCRL-83) MAGNETIC SUSCEPTIBILITIES OF ERBIUM AND HOLMIUM ETHYLSULPHATES. Technical (Scientific) Note No. 2. A. H. Cooke, R. Lazenby, and M. J. M. Leask (Oxford Univ. Clarendon Lab.). June 1960. Contract AF61(052)-92. 31p. (AD-253433)

The magnetic susceptibilities of erbium and holmium ethylsulfates were measured at temperatures between room temperature and 1.3°K. The results were compared with the values calculated from paramagnetic resonance data, and good agreement was obtained. The susceptibility of the erbium salt at low temperatures can be accounted for by a ground doublet having $g_{||} = 1.58 \pm 0.05$ and $g_{\perp} = 8.53 \pm 0.05$, with the lowest excited states some 50 cm^{-1} above the ground doublet. The susceptibility of the holmium salt in the helium range of temperatures can be accounted for by a triplet ground state having $g_{||} = 7.70 \pm 0.05$ and $g_{\perp} = 3.86 \pm 0.05$, split into a doublet and a singlet, the singlet being 5.5 cm^{-1} above the doublet. The Jahn-Teller splitting of the doublet is not more than 0.1 cm^{-1}. (auth)

24078 (AFCRL-TR-60-418) STUDY OF SPUTTERING OF MATERIALS. Final Report, April 15, 1959–October 14, 1960. Report No. 2133. G. K. Wehner, N. Laegreid, and R. V. Stuart (General Mills, Inc., Minneapolis). Oct. 1960. Contract AF19(604)-5536. 75p. (PB-171513)

Sputtering yield measurements for nitrogen, hydrogen, and neon ion bombardment at energies up to 1 kev are presented. The hydrogen and nitrogen results are considered questionable, because difficulties arose with the undetermined ratio of molecular to atomic ions, and with surface compounds which form at the target surface. The neon yield results for 28 metals and semiconductors showed that an important parameter in sputtering is the degree of filling of the d-shells of the target atoms. Yield measurement at very low bombarding ion energy is discussed. A new spectroscopic method which allows the instantaneous measurement of sputtering yields down to 10^{-5} atoms/ion is described. It was found that yields at 10 ev bombarding energy become so small that erosion effects at a satellite surface should never pose any problems. Sputtering effects on the moon's surface are discussed. About 40 meters of material should be sputtered in 10^9 years under solar wind bombardment. The surface of the moon was modified under this action in that loose dust particles were fused together by sputtered atoms into a porous but rather solid crust. Sputtering, furthermore, provides an explanation for the smoothness of the lunar surface on a 10 cm scale. (auth)

24079 (AFOSR-TN-60-1131) ELECTRONIC STRUCTURE OF THE GROUND STATE OF THE LITHIUM HYDRIDE MOLECULE. Darrell D. Ebbing (Indiana. Univ., Bloomington. Theoretical Chemistry Lab.). Sept. 1, 1960. Contract AF49(638)-318. 86p. (AD-249986)

A thesis is presented which is concerned with a quantum-mechanical treatment of the molecular LiH ground state. A study of this approach was conducted to discover what the advantages and disadvantages may be when applied to other systems. Such features of the electronic structure as may be revealed by the results were also examined. Results of each configuration interaction were analyzed into inner- and outer-shell correlation energies. It was found that those configurations are most important which have the inner-shell molecular orbital or the valence-shell molecular orbital doubly occupied. (J.R.D.)

24080 (AFOSR-TR-60-184) IONIZATION MEASUREMENTS IN GAS BUBBLE CHAMBER AND STUDY OF NUCLEATION PROCESSES AND GROWTH DYNAMICS OF GAS-BUBBLE IN STRONGLY OVERSATURATED GAS-LIQUID SOLUTIONS. Technical (Final) Report, June 1959–July 1960. P. E. Argan, A. Gigli, and E. Picasso (Genoa. Università. Istituto di Fisica); V. Bisi and G. Piragino (Turin. Università. Istituto di Fisica), and G. Bendiscioli (Pavia, Italy. Università. Istituto di Fisica [Superiore]). Nov. 14, 1960. 46p. (AD-253268)

Work was carried out on the photographic material obtained by exposing a one-liter working volume gas bubble chamber to the gamma beam of the 31-Mev betatron. Measurements and calculations were made of the energy loss of fast electrons. The design and construction of a 15-liter working volume gas bubble chamber is described. This chamber will be used with the 1100-Mev electron synchrotron at Frascati, Italy, to study the energy loss of fast particles in sensitive gas-liquid mixtures of various natures. The results obtained during the experimental study of the characteristics of some sensitive gas-liquid mixtures having peculiar properties, essentially with regard to their stopping power and their efficiency in the conversion of high energy gamma rays, are presented. (auth)

24081 (GA-2094) EFFECT OF COLLISIONAL ENERGY LOSS ON IONIZATION GROWTH IN H_2. L. D. Pearlstein and G. W. Stuart (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Mar. 22, 1961. 21p.

The effects of electron energy loss in collisions with gas molecules on the rate of ionization growth of H_2 gas in a constant external electric field were examined. An exact solution was derived for the growing part of the electron distribution function. The Boltzman equation for the single electron distribution function was transformed with respect to time and average over the velocity orientation. An integral equation relating the single electron history to the distribution function of all electrons was constructed. (M.C.G.)

24082 (LA-2530) CONSIDERATIONS IN THE DESIGN OF ENERGY STORAGE CAPACITOR BANKS. E. L. Kemp (Los Alamos Scientific Lab., N. Mex.). Mar. 1, 1961. Contract W-7405-ENG-36. 35p.

A description is given of the components and circuits presently in use in capacitor bank design. The characteristics of energy storage capacitors and typical cost data are given. Two types of switches are generally used: spark gaps and ignitrons. A vacuum spark gap is shown that will operate from 100 to 20 kv. A four-element spark gap is shown that will operate from 65 to 100 kv. The characteristics of ignitrons in bank service are described. Three types of transmission systems are discussed. Four types of charging systems are described and equations are given for their design. Some typical bank circuits are presented. The equations required for bank design are given. Capacitor bank safety and operating procedures are examined. (auth)

24083 (MND-P-2483-1) TASK 8—STRONTIUM-90 FUELED THERMOELECTRIC GENERATOR DEVELOPMENT. SNAP Programs Quarterly Progress Report No. 1, November 1, 1960 through January 31, 1961. W. S. West (Martin Co. Nuclear Div., Baltimore). Contract AT(30-3)-217. 78p.

Design and engineering analysis data are presented for four SNAP-7 Sr^{90}-fueled thermoelectric generators of 5- and 30-watt power. Fuel process flow and associated equipment requirements for remote conversion of Sr^{90} feed material to $SrTiO_3$ pellets are given together with fuel specifications. (D.L.C.)

24084 (NASA-TR-R-108) MEASUREMENTS OF THE DISSOCIATION RATE OF MOLECULAR OXYGEN. Charles J. Schexnayder, Jr. and John S. Evans. (National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.). 1961. 38p.

The ability of molecular oxygen to absorb light in the Schumann-Runge ultraviolet region of the spectrum was used to follow the change in concentration of molecular oxygen as a function of time behind shock waves in oxygen and in a mixture of 10% oxygen in argon. Analysis of the records obtained yielded values for the dissociation rate of oxygen as a function of temperature over the range 4,000 to 10,000°K. The highest previously reported experimental results in the literature were at 7,500°K. (auth)

24085 (NP-10304) RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USE RANGE OF THE ELECTROMAGNETIC SPECTRUM. R. Novick. Consists of thesis: ENHANCED HARMONIC GENERATION IN MAGNETRONS. Walter Strauss (Columbia Univ., New York. Columbia Radiation Lab.). June 1, 1961. Contract DA-36-039-SC-78330. 95p.

An X-band rising sun harmonic generator magnetron was developed. In order to obtain enhanced second harmonic output power, the magnetron had to be designed such that the resonant frequency of the second harmonic π-mode was twice the frequency of the fundamental π-mode. Second harmonic efficiency, the ratio of second harmonic output

power to input power, was strongly magnetic field dependent. Large values of second harmonic efficiency and output power occurred for operation in the "valley of efficiency" of the rising sun anode, i.e., for magnetic fields near B = $13000/\lambda_1$ gauss where λ_1 is the wavelength of the fundamental π-mode. Maximum second harmonic efficiency and output power at $\lambda_2 = 1.69$ cm were 13% and 46 kw respectively. For operation at these magnetic fields the ratio of generated second harmonic to fundamental power, was of the order unity. This large power ratio can be understood in terms of a phase shift between the fundamental voltage and the current which drives it, together with a modified rotating wave hypothesis were a waving motion, caused by the $\Gamma = 0$ Hartree component of the azimuthal electric field, is superimposed on the conventional rotation of the space charge spokes. (auth)

24086 (NP-10338) RESEARCH SUMMARY NO. 36-8 FOR THE PERIOD FEBRUARY 1, 1961 TO APRIL 1, 1961. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). May 1, 1961. Contract NASw-6. 117p.

Research progress is reported on trajectory analysis, orbit determination, space flight studies, low-thrust trajectory optimization, powered flight studies, cyrogenic gyros, gas-supported spinning spheres, ferromagnetic flux reversal mechanisms, closed-cycle gas supply system, low-noise amplifiers, antennas for space communications, thin-film techniques, communications, information processing, digital communications techniques, Venus radar experiment, high-resolution nuclear magnetic resonance spectroscopy, fission electric cells, stability of a shear layer in a magnetic field, similarity solution for stagnation point heat transfer, hot-wire anemometer in hypersonic flow, graphite, endothermal materials, behavior of materials in space, structural materials, liquid surface shapes, free-fall capsule to study weightless liquid behavior, 20-in. supersonic wind tunnel, instrumentation facilities, instrument performance studies, combustion and injection of liquid propellant, heat transfer, and fluid mechanics. (M.C.G.)

24087 (NP-10365) THERMOELECTRIC MATERIALS AND DEVICE RESEARCH. Quarterly Progress Report No. 6, Covering Period February 18, to May 17, 1961. B. Gossick, L. Stubbe, J. Morrison, and H. Whitehurst (Arizona State Univ., Tempe). Contract DA 36-039 SC-85249. 24p.

A number of samples of high-density polycrystalline rutile were prepared. These samples, in the form of small slices with one polished face, were partially reduced and a film of titanium dioxide was deposited on the polished face. Samples made in this way showed rectifying properties, and the electrical characteristics were found to depend on the manner in which the film of oxide was deposited. Colloidal tungsten particles were made by reducing the size of tungsten spheres electrolytically. These particles were mixed with precipitated titanium dioxide and consolidated into polycrystalline rutile by controlled dehydration. The temperature of ignition used in this series of experiments was high enough to cause complete oxidation of the metal, and the final samples were considered unsatisfactory for this reason. The electrical properties of rectifying barriers on rutile were studied. Measurements of d-c characteristic curves and transient behavior are described. A substantial increase in reverse breakdown voltage is reported. The injection ratio of most contacts made during the past quarter was small compared with unity, which precluded obtaining additional information about the properties of holes. (auth)

24088 (NP-10414) PULSED NUCLEAR MAGNETIC RESONANCE IN ALKALI HALIDES. Technical Report No. 5. W. G. Clark (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). June 1961. Contract NOnr-401(15). 143p.

Free induction decay shape, quadrupolar echo shape, and spin-lattice relaxation time (T_1) measurements were made on single crystals for Br^{79} and Br^{81} in KBr, I^{127} in KI, and Na^{23} and I^{127} in NaI:Tl. The measurements were performed over a temperature range from 77°K to near the melting point of each substance. The T_1 measurements for these substances can be broken into two categories: a temperature range (below 550°K for NaI:Tl and KBr, below 900°K for KI) which, except for Na^{23} at 77°K, yielded T_1 measurements intrinsic to the material and whose temperature dependence was in substantial agreement with that predicted by the Van Kranendonk two phonon process and a high temperature range where T_1 measurements depended on the particular sample used, and the dominant T_1 mechanism was diffusion motional relaxation via quadrupolar coupling. At 300°K, T_1 for I^{127} in KI was 0.0156 ± 0.005 sec, for I^{127} in NaI:Tl was 0.0102 ± 0.0003 sec, for Na^{23} in NaI:Tl was 8.46 ± 0.43 sec, for Br^{79} in KBr was 0.0725 ± 0.0025 sec, and for Br^{81} in KBr was 0.104 ± 0.003 sec. Above 175°K, measurements in the temperature range for intrinsic values of $(T_1)^{-1}$ were fitted by a power law dependence on the absolute temperature. This temperature dependence was $T^{1.85 \pm 0.07}$ for I^{127} in KI, $T^{1.91 \pm 0.08}$ for Br^{79} and Br^{81} in KBr, $T^{1.84 \pm 0.07}$ for I^{127} in NaI:Tl, and $T^{1.78 \pm 0.13}$ for Na^{23} in NaI:Tl. No evidence for the Khutsishvili four phonon T_1 mechanism was observed. In KBr free induction decay and quadrupolar echo shapes showing the dependence of quadrupolar broadening on the orientation of the crystal relative to the external magnetic field H_0 were measured. In all substances studied, quadrupolar broadening disappeared at high temperatures. The disappearance was interpreted as arising from the annealing of dislocations, which reappear when the crystal is cooled to room temperature. At temperatures on the order of 600°K diffusion increased the free induction decay lifetimes; at still higher temperatures, free induction decay lifetimes decreased. This decrease was tentatively ascribed to quadrupolar broadening by vacancies. Calculations of the effects of diffusion on the quadrupolar part of free induction decay and echo shapes are presented. These calculations show that diffusion will slow the decay of the quadrupolar part of a free induction decay and attenuate, broaden, and delay the appearance of a quadrupolar echo. A method for the separate measurement of $|\Delta m| = 1$ and $|\Delta m| = 2$ T_1 transitions in a spin $\frac{3}{2}$ system subject to quadrupolar relaxation but not a spin temperature constraint is proposed. The spin echo apparatus used for the experiments is described in detail. (auth)

24089 (NRL-5489) ELECTRICALLY EXPLODED WIRES—EXPERIMENTS AND THEORY, PROGRESS REPORT FOR MARCH 1, 1958 TO JUNE 30, 1960. J. B. Langworthy, R. C. O'Rourke, M. P. Shuler, I. M. Vitkovitsky, C. B. Dobbie, R. J. Veith, and D. F. Hansen (Naval Research Lab., Washington, D. C.). May 5, 1961. 132p. (DASA-1174)

Design details of the high-temperature laboratory are given. An elementary theory of the processes which might occur in an exploding wire is outlined and, where possible, numerical examples are presented which can be applied to experiments. The electronic instrumentation program which includes traveling-wave scope techniques for measuring current and power in exploding wires with 10^{-9} sec resolution is described. Equipment development centered around three capacitor systems which are referred to as the Mylar capacitor, the water capacitor, and the Mylar-

water capacitor. The relevant parameters for the LRC circuits made from the three discharge systems and the exploding wire are listed. The Mylar capacitor was designed as the primary system in the program to obtain high-intensity x-ray pulses from exploding wires. The Mylar-water capacitor was developed to obtain a high-voltage capacitor with a discharge time approaching 10^{-8} seconds. The water capacitor was developed for use in exploding foils to produce strong shocks in solids. The high-speed optical instrumentation for exploding wire phenomena is described. (M.C.G.)

24090 (ORNL-3104(p.46-69)) VACUUM ARC RESEARCH. P. M. Griffin, G..K. Werner, J. E. Francis, et al. (Oak Ridge National Lab., Tenn.).

Carbon Arcs. An analysis of the dependence upon arc current of the rotational frequency of C^{2+} ions as evidenced by the Doppler slant of spectral lines showed the dependence to be nonmonotonic. The ratio of the rotational frequency to the square of the half-width is empirically found to follow a linear relationship with the arc current. Lithium Arcs. Anode development for lithium vacuum arcs is described. Anode cooling conditions were found that yield Li^{2+} in strong admixture with Li^+ in the arc. The current carried by positive ions is found to be 19% or more of the total arc current. Doppler shifts indicate a longitudinal drift energy of 70 ev for the Li^+ ions, while line widths suggest on apparent temperature of about 10 ev. Ballistic measurements made in the lithium positive ion current that misses the cathode indicate a thrust force of about 2 g for a total arc current of about 100 amp. Anomalous brightness of the 5484.8 line of Li^+ is suggested to arise from population of the $2s(^3S)$ metastable triplet state. Deuterium Arcs. The development work on a high-vacuum deuterium arc is reviewed. Electrodes were developed which do not deteriorate with prolonged use and which introduce no impurities into the arc plasma. A variety of spectroscopic and microwave observations is described. The observed impurity level (CO and organic) is 0.06%. The arc column appears to be a 99%-ionized plasma with an ion temperature of 16 ev and an electron temperature somewhat higher. Its maximum density is of the order 10^{14} particles/cm^3. The ions carry approximately 25% of the arc current. (auth)

24091 (ORNL-3104(p.121-2)) CROSS-SECTION MEASUREMENTS. D. P. Hamblen, L. A. Massengill, and Herman Postma (Oak Ridge National Lab., Tenn.).

Apparatus has been readied for the measurement of the cross section for dissociation of H_2^+ by electrons, using crossed beams. Estimates are given for the degree to which noise and ripple must be suppressed. A suggestion is made for an experiment to measure the cross section for dissociation of H_2^+ by H^+. (auth)

24092 (ORNL-3104(p.123-37)) VACUUM SYSTEMS AND TECHNIQUES. C. E. Normand, F. A. Knox, R. V. Neidigh, et al. (Oak Ridge National Lab., Tenn.).

Comparative pumping speeds of evaporated titanium were measured for H_2, CO, CO_2, N_2, O_2, He, Ar, and CH_4. The last three are found not to be pumped at all. Comparisons of several evaporated metals as adsorbers of H_2 were made with the result that under the conditions of the experiment Ti seems better than Mo, Zr, Cr, Ta, Li, or Nb. A three-cell titanium differential pumping unit was tested for possible use at the points at which an injected ion beam might enter or leave a low-pressure region containing accumulated plasma. Radiation from a carbon arc was found in a brief test to have an inappreciable effect upon the steady-state pumping action of titanium under evaporation. Some studies of ionization-gage calibrations are described, which indicate that the calibration of a given RG-75 gage remains constant with time, but if either RG-75 or VAC-NIG gages are used without their envelopes, they may be completely unreliable. A study is reported of isotherms around the jets of diffusion pumps. (auth)

24093 (ORNL-3104(p.138-9)) STATUS OF BALL-LIGHTNING STUDY. J. R. McNally, Jr. (Oak Ridge National Lab., Tenn.).

Some remarks are made upon a collection of reports of observations of ball lightning. (auth)

24094 (R60SD477) THE STARK EFFECT IN LITHIUM. Technical Information Series. R. G. Breene, Jr. (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Mar. 1961. 16p. (AD-253392)

The familiar hydrogenic form for the lithium outer orbitals is first demonstrated as justification for their application to matrix element calculation. The spin-orbit interaction for the 4d and 4f levels was computed. Under the approximation of zeroth-order degeneracy the linear Stark Effect for the 4d level was calculated for field strengths of 20,000 volts/cm and greater. Under the approximation of no zeroth-order degeneracy the quadratic Stark Effect was computed for field strengths of 20,000 volts/cm and less. (auth)

24095 (TID-13043) THE SIXTEENTH ANNUAL MEETING OF THE STANDARDS AND METROLOGY DIVISION OF THE AMERICAN ORDNANCE ASSOCIATION, HELD ON FEBRUARY 15 AND 16, 1961, SANDIA BASE, ALBUQUERQUE, NEW MEXICO. (Sandia Corp., Albuquerque, N. Mex.). 67p. (SCDC-2335)

Six papers and a forum discussion are included which were presented at the 1961 meeting of the Standards and Metrology Division of the American Ordnance Association. The topics which were treated included statistics, systematic errors, electronic metrology, and dimensional metrology. (D.L.C.)

24096 (TID-13187) THERMAL CONDUCTIVITY OF LIQUID He^3. Technical Report No. 3. Ansel C. Anderson (Illinois. Univ., Urbana). May 1961. Contract AT(11-1)-67. 88p.

The thermal conductivity of liquid He^3 was measured in the temperature range from 0.026 to 0.2°K at pressures near 10 cm Hg by measuring the temperature difference across a column of liquid through which a constant flow of heat is maintained. The conductivity was found to increase as temperature was decreased, attaining a dependence on temperature of T^{-1} below 0.04°K. The thermal conductivity K was calculated from the relation $K = (\dot{Q}/\Delta T)(L/A)$ where $\dot{Q}$ is the heating rate, ΔT is the temperature difference between two resistance thermometers, and L/A is the ratio of length to cross sectional area of the He^3 column. The conductivity data below 0.04°K were found to fit the relation $K = AT^n$, where $A = (48 \pm 3)$erg/cm sec K^{n2} and $n = (1.0 \pm 0.1)$. This dependence on temperature agrees with that derived by Abrikosov and Khalatnikov from the Landau theory of a Fermi liquid. (auth)

24097 (UCRL-6450(Pt.I)) EVALUATION OF SOME INTEGRALS ARISING IN THE THEORY OF IONIZED GASES. John G. Trulio and Stephen G. Brush (California. Univ., Livermore. Lawrence Radiation Lab.). May 17, 1961. Contract W-7405-eng-48. 11p.

In some recent theories of the equation of state of classical ionized systems, the free energy depends on integrals of the form $\int_0^\infty [e^{-\beta V_s} - 1 + \beta V_s - \beta^2 V_s^2/2] r^2\, dr$, where V_s is a "screened" potential obtained from the real potential by summing certain infinite series of diagrams. This integral

is tabulated for V_s appropriate to a potential $\pm (e^2/r)(1 - e^{-\gamma r})$. The equation of state is also given for a one-component electron gas in a uniform background of positive charge (limit $\gamma \to \infty$). (auth)

24098 (UCRL-9602) THE ELECTRON SPIN RESONANCE ABSORPTION OF TWO SOLID-STATE PARAMAGNETIC CENTERS. PART I. FROZEN "TETRAMETHYL AMMONIUM" SOLUTIONS. PART II. CRESTMORE BLUE CALCITE (thesis). Larry R. Doyle (California. Univ., Berkeley. Dept. of Chemistry and California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 10, 1961. Contract W-7405-eng-48. 55p.

The electrolytic reduction of tetramethyl ammonium iodide, dissolved in liquid ammonia, yielded a blue solution called "tetramethyl ammonium." The paramagnetic resonance spectrum of this material cooled below the freezing point of ammonia was examined. A single-line spectrum was observed at 8750 Mc/sec, with g = 2, Δh_{msl} = 2.3 gauss, and a line shape intermediate between Gaussian and Lorentzian. The origin of this spectrum and its line shape is discussed. The paramagnetic resonance spectrum of Crestmore blue calcite was examined. At 77°K a nearly isotropic quartet was observed with g = 2.011 ± 0.002. When the calcite was bleached, this quartet could not be observed. The appearance of the quartet suggests an isotropic hyperfine interaction for a nucleus with I = $^3/_2$ and with a/h = 22 ± 1 Mc/sec. (auth)

24099 (UCRL-9642) SOME USEFUL TABLES FOR NUCLEAR SPECTROSCOPY IN TRANSMERCURY GROUP OF ELEMENTS: ELECTRON BINDING ENERGIES, X-RAY ENERGIES, AUGER ELECTRON ENERGIES AND FLUORESCENT YIELDS. Earl K. Hyde (California. Univ., Berkeley. Dept. of Chemistry and California. Univ., Berkeley. Lawrence Radiation Lab.). May 1, 1961. Contract W-7405-eng-48. 29p.

Tables are presented for elements in the atomic number range 80 to 104 for the following properties: electron binding energies, x-ray energies, Auger electron energies, and fluorescent yields. (D.L.C.)

24100 (WADD-TR-60-699(Vol.I)) ENERGY CONVERSION SYSTEMS REFERENCE HANDBOOK. VOLUME I. GENERAL SYSTEM CONSIDERATIONS. W. R. Menetrey and J. H. Fisher (Electro-Optical Systems, Inc., Pasadena, Calif.). Sept. 1960. Contract AF33(616)-6791. 134p. (EOS-390-Final (Vol.I))

General topics useful in evaluating and rating power systems are discussed including the space environment and its effects, reliability considerations in systems design, figures of merit and their use in system evaluation, power needs of the future and the importance of developing power systems, and an estimate of expected system weights. Environmental effects include meteoroid bombardment, interplanetary and Van Allen radiation, electromagnetic solar radiation, and vacuum. It is shown that the efforts needed to guarantee high-power system reliability may be too costly. The relative position of nuclear, chemical, and solar power systems in a power level-mission duration continuum is presented. (auth)

24101 (WADD-TR-60-699(Vol.II)) ENERGY CONVERSION SYSTEMS REFERENCE HANDBOOK. VOLUME II. SOLAR-THERMAL ENERGY SOURCES. D. H. McClelland and C. W. Stephens (Electro-Optical Systems, Inc., Pasadena, Calif.). Sept. 1960. Contract AF33(616)-6791. 403p. (EOS-390-Final (Vol. II))

Basic problems in the development of lightweight, high efficiency, solar concentrating mirrors for space power systems are discussed. Various concentrator and absorber configurations are compared both on the basis of idealized performance and in regard to performance degradation due to geometric errors. Concentrator structural design classifications are presented and are related to fabrication techniques, materials, and reflective surfacing methods. Orientation requirements and the effects of the space environment are considered. Tests are presented for determining collector performance and for evaluating mirror surface quality. (auth)

24102 (WADD-TR-60-699(Vol.III)) ENERGY CONVERSION SYSTEMS REFERENCE HANDBOOK. VOLUME III. DYNAMIC THERMAL CONVERTERS. C. W. Stephens, R. Spies, W. R. Menetrey (Electro-Optical Systems, Inc., Pasadena, Calif.). Sept. 1960. Contract AF33(616)-6791. 211p. (EOS-390-Final (Vol.III))

A detailed discussion is presented of the two dynamic thermal converters which appear most useful in future power systems in the next decade, the Stirling engine and the Rankine cycle turbine. Empirical and theoretical equations are presented describing engine performance, and estimates are made of future performance possibilities with new working fluids and higher operating temperatures. Also discussed are electrostatic and electromagnetic generators which are coupled with the dynamic thermoconverters. Anticipated weights, efficiencies, and other performance characteristics are described. (auth)

24103 (WADD-TR-60-699(Vol.IV)) ENERGY CONVERSION SYSTEMS REFERENCE HANDBOOK. VOLUME IV. STATIC THERMAL CONVERTERS. J. Blair and J. D. Burns (Electro-Optical Systems, Inc., Pasadena, Calif.). Sept. 1960. Contract AF 33(616)-6791. 209p. (EOS-390-Final(Vol.IV))

Two static thermal converters of prime interest to space power systems, the thermoelectric generator and the thermionic emitter, are described. Empirical and analytical relations describing their performance are presented. Performance is optimized as a function of heat sink and source temperatures, material parameters available at present and anticipated in the future, and fabrication limitations. While the efficiencies of present devices are lower than obtainable with dynamic heat engines, material improvements are expected to reverse this situation and result in converter efficiencies on the order of 30 to 40% for thermionic emitters, and 25 to 30% for thermoelectric generators within the next decade. (auth)

24104 (WADD-TR-60-699(Vol.VI)) ENERGY CONVERSION SYSTEMS REFERENCE HANDBOOK. VOLUME VI. CHEMICAL SYSTEMS. W. R. Menetrey and J. Chrisney (Electro-Optical Systems, Inc., Pasadena, Calif.). Sept. 1960. Contract AF33(616)-6791. 198p. (EOS-390-Final(Vol.VI))

Power systems which use chemical fuel as the energy source appear useful in a variety of space applications, and offer weight advantages for durations below about 100 hours. Primary and secondary batteries, primary and regenerative fuel cells, reciprocating engines using hydrogen and oxygen bipropellant, monopropellant and bipropellant turbines and cryogenic storage of hydrogen and oxygen are discussed. The theoretical and practical performance of the converters is reviewed, and the weight of various systems is predicted. Other factors besides power system weight may lead to the selection of a chemical system in preference to others. For example, liquid hydrogen provides an excellent heat sink for environmental control. While batteries may be approaching the limits of their capability, major advances still will be accomplished in the fuel cell and dynamic engine area. For durations of

more than several hours primary system weights of 1 to 1.5 lb/hp hr and secondary specific weights of up to 100 watt-hr/lb appear possible by 1970. (auth)

24105 (WADD-TR-60-699(Vol.VIII)) ENERGY CONVERSION SYSTEMS REFERENCE HANDBOOK. VOLUME VIII. OTHER DEVICES. R. Wall, D. Erway, R. Spies, J. D. Burns, and D. McDowell (Electro-Optical Systems, Inc., Pasadena, Calif.). Sept. 1960. Contract AF33(616)-6791. 144p. (EOS-390-Final (Vol.VIII))

The performance characteristics of several auxiliary components useful in space power systems including orientation mechanisms, pumps, and static conversion and regulation devices are described. In addition, the MHD generator is analyzed as a thermal energy converter, and the possibilities of using beamed electromagnetic power are discussed. Weight, efficiency, power requirements, and other design characteristics of the auxiliary equipment are presented in empirical and analytical form. It is shown that beamed electromagnetic power does not appear useful until major breakthroughs in antenna design and theory are achieved. The theoretical relations describing the MHD generator and the possibilities of its eventual use in thermal systems are described. (auth)

24106 (WADD-TR-60-699(Vol.IX)) ENERGY CONVERSION SYSTEMS REFERENCE HANDBOOK. VOLUME IX. SOLAR SYSTEM DESIGN. W. R. Menetrey (Electro-Optical Systems, Inc., Pasadena, Calif.). Sept. 1960. Contract AF33(616)-6791. 95p. (EOS-390-Final (Vol.IX))

A summary of the anticipated performance of solar power systems over the next decade is presented. This summary is based on the analytical and empirical relationships describing component performance presented in pervious volumes. Weight, cost, and reliability estimates are presented for photovoltaic power systems, and weight estimates are given for solar-thermal systems. Thermal converters include thermoelectric discs, thermionic emitters, turbo-generators, and the Stirling engine. (auth)

24107 (WADD-TR-60-699(Vol.X)) ENERGY CONVERSION SYSTEMS REFERENCE HANDBOOK. VOLUME X. REACTOR SYSTEM DESIGN. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif. and Electro-Optical Systems, Inc., Pasadena, Calif.). Sept. 1960. Contract AF33(616)-6791. 122p. (EOS-390-Final(Vol.X))

Various aspects of reactor design for space applications with respect to inherent limitations and system requirements are discussed. Problems such as shielding, reliability, heat rejection, and safety are outlined. (auth)

24108 (WADD-TR-60-699(Vol.XI)) ENERGY CONVERSION SYSTEMS REFERENCE HANDBOOK. VOLUME XI. RADIOISOTOPE SYSTEM DESIGN. (Martin Co., Baltimore and Electro-Optical Systems, Inc., Pasadena, Calif.). Sept. 1960. Contract AF33(616)-6791. 315p. (EOS-390-Final (Vol.XI))

Direct-conversion, nuclear-powered thermoelectric auxiliary power units offer promise for space vehicle applications because of their reliability and simplicity. Radioisotopes suitable for fueling these units will become more plentiful in the future from by-products of other nuclear programs. Extensive research and development work was carried out on isotopic-powered generators. This work in basic technology, radiation safety, and specific equipment design is described. Basic work includes methods of preparation and containment of fuels, energy conversion systems, and generator design principles. Prevailing concern over radiological hazard is answered by discussion of each possible hazard situation from gound handling to various vehicle missions, including aborts. Five practical generator designs are presented including SNAP IA, a 125-watt, one-year generator using Cerium-144, and the Polonium-fueled SNAP III, both of which have progressed to the advanced hardware stage. A comparison of nuclear- and solar-powered generators indicates some advantage for the nuclear device for requirements of less than 1 kwe when the mission involves long periods of flight away from the sun. (auth)

24109 (AEC-tr-4660) A NEW METHOD FOR THE ABSOLUTE MEASUREMENT OF THE THERMAL CONDUCTIVITY OF SMALL SAMPLES. Jan Bednar. Translated from Czechoslov. J. Phys., 3: 170-1(1953). 2p.

The method described makes possible the measurement of the thermal conductivity of small samples independent of how well the sample is insulated from the surrounding media. The thermal conductivity of the specimen may be found by the equation: $(Q/t) = -\lambda q\,(dT/dx)$, where q is the sample cross section, (dT/dx) is the temperature gradient along the sample, λ is the coefficient of thermal conductivity, and (Q/t) is the heat flow at any point along the specimen. (B.O.G.)

24110 (NP-tr-582) COMPENSATION OF AN ELECTRONIC VOLUMETRIC CHARGE BY ALKALI METAL IONS. M. E. Gurtovii (Gurtoviyl) and N. M. Livshits. Translated from Nauk Zapiski Kiiv. Derzhan. Univ. im. T. G. Shevchenka, 15: No. 9, Zhirnik Fiz. Fak. no. 5, 93-100(1956). 15p.

It was found to be possible to utilize alkali metal ions formed by contact ionization on the surface of red hot cathode for the compensation of an electronic volumetric charge. In this case it was possible to obtain a saturation current in the absence of outer accelerating potential difference, provided that the pressure of the alkali metal was sufficiently high. (auth)

24111 (NP-tr-673) CERTAIN EXACT SOLUTIONS OF THE EQUATIONS OF UNSTEADY MOTION IN MAGNETIC HYDRODYNAMICS. Yu. P. Ladikov. Translated from Doklady Akad. Nauk S.S.S.R., 137: 303-6(1961). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, as abstract no. 20264.

24112 (NP-tr-685) INVESTIGATING SEMICONDUCTOR THERMOELEMENTS. Yu. N. Malevskii (Malevskiy) and A. S. Okhotin. Translated from Teploenergetika, No. 2, 78-87(1960). 17p.

The design of thermoelectric generators, operating on the principle of thermoelectric phenomena, in connection with the development of solid state physics and semiconductor materials is discussed. The requirements for materials and conditions for maximum effectiveness of operation are outlined. The preparation and properties of various tellurides are described. The dependence of the properties on temperature is discussed. Methods of constructing thermoelements are described. (M.C.G.)

24113 (SCL-T-365) NEW PRINCIPLES FOR CONSTRUCTION OF ELECTROMAGNETIC SEISMOGRAPHS. J. Coulomb and G. Grenet. Translated by A. A. Horvath and Marcel I. Weinreich from Ann. phys. (11), 3: 321-69 (Apr. 1935). 44p.

Basic principles are pointed out for the construction of apparatus displaying given properties. As an application of same, several projects of apparatus which illustrate the richness of this method are given. The first example proves that it is possible to realize the exact equivalent of

a Galitzine apparatus with a pendulum and a galvanometer of different periods, bringing thus a roundabout solution to the difficult problem of Galitzine's vertical pendulums of long period. Another class of apparatus exhibits characteristics similar to a mechanical device, as represented by Wenner's apparatus, but it has an amplification and a period which it is impossible to achieve by ordinary means. A method is given which shows how to determine the constant of an apparatus in such a way as to have the amplification remain constant over a large number of periods. (auth)

24114 (UCRL-Trans-670(L)) ON THE STATISTICAL THEORY OF IONIC SYSTEMS. I. R. Yukhnovskii (Iukhnovskii). Translated by Stephen G. Brush (Univ. of California. Lawrence Radiation Lab.) from Ukrain. Fiz. Zhur., 4: 167-76(1959). 13p.

A compact formula for the free energy of a neutral system of ions is presented and discussed. The binary and ternary distribution functions of the system are also considered. A method of functional differentiation is given which leads to Coulomb distribution functions without short-range forces. (auth)

24115 (UCRL-Trans-672(L)) HEAT CAPACITY OF A GAS AT HIGH TEMPERATURES. B. L. Timan. Translated by Stephen G. Brush (Univ. of California. Lawrence Radiation Lab.) from Zhur. Eksptl'. i Teoret. Fiz., 27: 262-4(1954). 3p.

The heat capacity of a gas at high temperatures is calculated taking ionization into account. It is shown that the correction for ionization depends on the temperature and that the heat capacity reaches a maximum at ~20,000°K. (D.L.C.)

24116 ON THE DENSE PHASES OF He^3 AT VERY LOW TEMPERATURES. Louis Goldstein (Los Alamos Scientific Lab., N. Mex.). Ann. Phys., (N. Y.), 14: 77-93 (July 1961).

A class of physical properties of the dense phases of He^3 are dominated at low temperatures by their nuclear spin systems. The latter determine the lower limits of these properties, and yield thereby approximately their behavior and limiting values at very low temperatures and at the absolute zero. The theory of the spin system allows one to estimate the lowest temperatures at which the various thermal properties of this class have to be determined experimentally to approach with a preset deviation their limiting values in the ground state of these dense phases. These determinations, with a common relative value of this difference, of the nuclear paramagnetic susceptibility, heat capacity, expansion coefficient, and their temperature rates of variation require decreasingly lower temperatures, with the latter finite quantities imposing temperatures one order of magnitude lower than the susceptibility. These studies suggest that in order to obtain satisfactory, experimentally inaccessible, extrapolated very low temperature behaviors and finite limits of the above class of properties, careful prior analysis of their finite temperature values will have to be performed in terms of the partial properties of the spin systems as well as those of the degrees of freedom other than spin of the dense phases of He^3. (auth)

24117 THE SCATTERING OF ELECTRONS BY ATOMIC HYDROGEN. Marvin H. Mittleman (Univ. of California, Livermore). Ann. Phys. (N. Y.), 14: 94-106(July 1961). (UCRL-5711)

A method is presented which reduces the problem to the scattering of a single electron in an equivalent potential. The complexities of the electron-electron interaction are embodied in this potential. An exact expression is given for the potential, and various approximation methods are discussed. The adiabatic approximation is investigated and the imaginary part of the potential is examined. (auth)

24118 PRECISION MEASUREMENT OF L X-RAY WAVELENGTHS AND LINE WIDTHS FOR $74 \leqq Z \leqq 95$ AND THEIR INTERPRETATION IN TERMS OF NUCLEAR PERTURBATIONS. John Jay Merrill and J. W. M. DuMond (California Inst. of Tech., Pasadena). Ann. Phys. (N. Y.), 14: 166-228(July 1961).

Techniques for the precision measurement of x-ray lines using the two-crystal spectrometer are discussed, and then applied to measurement of the L x-ray spectra of the transuranic elements uranium, neptunium, plutonium, and americium. In all, 52 emission lines and 4 L_{III} absorption edges were measured, all of them with higher precision than has heretofore been obtained and many of them for the first time. Using these data, the binding energies of the electrons for these atoms were computed. The L_{II}-L_{III} level splitting was computed and compared with theory and it was found that current theory is not sufficient to account quantitatively for the observed data. Certain features of the emission line widths are discussed and given qualitative explanations in terms of the Coster-Kronig transition L_{II}-$L_{III}M_V$ and hyperfine structure. The observed hyperfine structure is due to the large magnetic moment of Np^{237} which leads to increased widths of certain of the Np lines. It is believed that this is the first experimental observation of hyperfine structure in x-ray spectra. (auth)

24119 SCATTERING FROM A PENETRABLE SPHERE AT SHORT WAVELENGTHS. S. I. Rubinow (Stevens Inst. of Tech., Hoboken, N. J. and New York Univ., New York). Ann. Phys. (N. Y.), 14: 305-332(July 1961).

A scalar plane wave incident on a penetrable sphere is considered in the short wavelength limit. A new representation of the scattering amplitude is introduced which is particularly appropriate in this limit, and which requires only the evaluation of certain integrals. Some of these may be evaluated asymptotically by the method of steepest descent and lead to the geometrical optics field contribution. Included in this is the bow field. The remainder of the integrals are evaluated by the method of residues and lead to the diffracted field contribution. This "diffracted ray" field is known from recent investigations in diffraction theory. An essential part of the analysis is the introduction of the parameter p, the number of internal refractions that a ray which hits the sphere undergoes. The results obtained are all in agreement with that which would be expected on the basis of geometrical diffraction theory. (auth)

24120 A NEW SOLUTION FOR THE TREATMENT OF GAS DYNAMIC PROBLEMS IN STRONG DEVIATIONS FROM THERMODYNAMIC EQUILIBRIUM. Fritz Weitzsch (Technische Hochschule, Hanover). Ann. Physik, (7) 7: 403-17(May 1961). (In German)

A new method for obtaining an approximation solution of the Boltzmann equation, which offers a series of advantages over earlier solutions, is proposed. The velocity distribution used in the solution permits principally an improved adjustment to the gas dynamic problem or to the to-be-expected deviations of the velocity distribution from equilibrium distribution. The utility of the solution was tested on an example of stationary compression. Arbitrary strong collisions were investigated by the model theory. The solutions can be considered as the next highest approximation of the treatment given by Mott-Smith. (tr-auth)

24121 THE CONTRIBUTION OF PHOTONS TO ELECTRON RELEASE FROM THE CATHODE IN GLOW DIS-

CHARGE IN Hg VAPOR. E. Badareu and F. Wächter (C. I. Parhon Univ., Bucharest). Ann. Physik, (7) 7: 418-24(1961). (In German)

A research arrangement, which permits the determination of the contribution of the photoeffect of an abnormal simple glow discharge and of a double cathode discharge to electron release at the electrode, is given. This contribution was determined for various cathodes in Hg vapors. From the results it was concluded that the photoeffect contributes in a small degree to electron release, but it can scarcely be used for the explanation of the current amplification by which the hollow cathode effect was characterized. (tr-auth)

24122 THE CALCULATION OF THE INTERACTION ENERGY OF TWO SIMILAR SINGLY NEGATIVELY CHARGED IONS WITH RARE-GAS ELECTRON STRUCTURE IN THE FERMI-AMALDI MODEL. T. Tietz (Univ. of Lodz, Poland). Ann. Physik, (7) 7: 425-8(1961). (In German)

A formula for the interaction energy of two similar negatively charged ions with rare gas electron structure was derived for the Fermi-Amaldi model. The Jensen method which Gombas brought to a simpler form was used. The extensive simplifications of Gombas permit the derivation of an analytical expression for the interaction energy in the Fermi-Amaldi model. (tr-auth)

24123 THE CONFIGURATIONS $(4d + 5s)^5$ IN THE SECOND SPECTRA OF THE PALLADIUM GROUP. Y. Shadmi (Hebrew Univ., Jerusalem). Bull. Research Council Israel, Sect. F, 9F: 141-70(Apr. 1961). (In English)

The experimental levels of the low even configurations of the second spectra of the palladium group (Sr through Cd) are compared with theoretical calculations. The significance of different approximations is discussed. Interpolation formulas for the interaction parameters enable calculation 650 levels using 36 free parameters, with a mean error of 84 cm^{-1}. (auth)

24124 STUDY OF THE INTRODUCTION OF RARE GASES IN METALS BY ELECTRIC DISCHARGE. Gilbert Brebec, Viviane Levy, and Yves Adda. Compt. rend., 252: 722-4(Jan. 30, 1961). (CEA-1921). (In French)

The use of Xe^{133} and Kr^{85} made it possible to determine the distribution of the rare gas inside a metal, as well as its concentration. (auth)

24125 THE SPECIFIC HEAT AT CONSTANT VOLUME, THE ENTROPY, THE INTERNAL ENERGY, AND THE FREE ENERGY OF LIQUID HELIUM-4 BETWEEN 1.2 AND 2.9°K. O. V. Lounasmaa (Argonne National Lab., Ill. and Wihuri Physical Lab., Univ. of Turku, Finland). Cryogenics, 1: 212-21(June 1961).

The thermodynamic functions tabulated for liquid He^4 are all functions of temperature (C_v from 1.2 to 2.9°K, S and $U - U_0$ from 1.5 to 2.9°K) and density (from $\rho = 0.150$ to 0.185 g/cm^3). These quantities, together with the free energy $F - U_0 = U - U_0 - TS$, are also presented in graphical form; some of the graphs include curves corresponding to liquid He along the liquid–vapor and liquid–solid equilibrium lines. A table giving the values of these functions along the λ curve is also included. (P.C.H.)

24126 A STUDY OF DEVELOPMENT DEFECTS AND TRACK STRUCTURES IN NUCLEAR EMULSIONS USING AMIDOL DEVELOPERS. O. N. Kaul (Saha Inst. of Nuclear Physics, Calcutta). Indian J. Phys., 35: 183-92(Apr. 1961). (In English)

For nuclear emulsions developed by the amidol process, development defects and the dependence of track and grain structures on the various development parameters are investigated. Formulas are suggested for the removal of microscopic fog, coloration defects, and background. (auth)

24127 GROWTH OF HYDROMAGNETIC SHOCK WAVES. I. J. Singh (Oil and Natural Gas Commission, Dehradun, India) and K. P. Chopra. Indian J. Phys., 35: 199-202(Apr. 1961). (In English)

The influence of a transverse magnetic field on the formation of a shock wave in an electrically conducting fluid is considered. It is concluded that the presence of a transverse magnetic field is conducive to the growth of compression waves and the decay of expansion waves. (auth)

24128 THE AVERAGE RULE COMPARED WITH THE COMPLETE ISOTOPIC RULE FOR VIBRATIONAL FREQUENCIES. Walter J. Lehmann (Hughes Tool Company-Aircraft Div., Culver City, Calif.). J. Mol. Spectroscopy, 7: 1-13(July 1961).

Vibrational frequencies of deuteroethylenes, deuterodiboranes, fluorochloroethylenes, and methyldiboranes are calculated by adaptations of the Complete Isotopic Rule (CIR) and the Average Rule (AR). Schematic diagrams are used to illustrate application of the AR for determining the various frequencies of partially deuterated ethylenes, such as the in- and out-of-phase stretching frequencies of cis-$C_2H_2D_2$. The AR is applied to bending modes as well as stretching vibrations. Its simplicity and ease of application make the AR attractive, even though the CIR, when applicable, yields better results. In many instances, particularly for stretching frequencies, both methods yield equally good results, making it difficult to justify the extra labor involved in a CIR-type calculation. The AR, however, should generally not be used for averaging widely separated frequencies, especially of bending modes. (auth)

24129 INVESTIGATIONS ON THE DECAY TIME OF LIQUID ORGANIC SCINTILLATORS. R. Reichel (Zentralinstitut fur Kernphysik, Rossendorf, Ger.). Kernenergie, 4: 285-90(Apr. 1961). (In German)

A study was made to obtain an approximate insight into the pattern of the energy transport between solvent and scintillator. The dependence of the decay time on the scintillator concentration was investigated in a number of solutions of primary scintillators in toluene and phenyl cyclohexane, using both β and α particles. The effect of the solution viscosity on the external decay time was measured on solutions with 20% paraffin oil. With the addition of small quantities of secondary scintillators, the decay time is unchanged. With increasing concentrations it increases to a maximum. (J.S.R.)

24130 DENSITY MEASUREMENTS OF SOIL, CONCRETE, ORE AND SIMILAR MATERIALS WITH THE GAMMA-RAYS SCATTERING METHOD. Vekoslav Ramšak (Nuklearni Inštitut "Jožef Stefan," Ljubljana, Yugoslavia). Nova Proizvodnja, 11: 250-3(1960). (In Yugoslavian)

Techniques for measuring the density of soil, concrete, ore, and similar materials by gamma scattering are presented along with some experimental results. The apparatus used for surface and depth density measurements is also described. By using the surface method the density of a 10 to 15 cm layer can be measured with an accuracy of 1.8 to 2.6% in the density range 1.9 to 7.8 g/cm^3. By depth density measurements an accuracy of 2.5 to 3.5% in the density range 1.4 to 2.0 g/cm^3 can be obtained. (N.W.R.)

24131 A NOTE ON ELECTRON PHOTON SHOWERS. A. Ramakrishnan (Univ. of Madras) and S. K. Srinivasan. Nuclear Phys., 25: 152-4(1961). (In English)

The mean square deviation of the number of electrons produced by electron or photon cascades, obtained by Monte Carlo methods is compared with results based on exact methods of stochastic theory. The degree of validity of Monte Carlo methods for such processes is discussed. (auth)

24132 DIFFUSION OF RADIOACTIVE MATERIALS THROUGH SOLID BODIES WITH GRANULAR STRUCTURE. Eberhard Kern and Alfred Schatz (Arbeitsgemeinschaft BBC-Krupp, Mannheim, Ger.). Nukleonik, 3: 61-76(May 1961). (In German)

A theory was developed on the diffusion of radioactive materials (particles with finite life time) in a solid body with granular structure. The particles can be fission products which originate in the grains of the solid by fission of uranium as a result of neutron capture. It is a question of a solid-body diffusion with heterogeneously arranged particle sources. The problem can be treated, in analogy to the theory of neutron diffusion in heterogeneous reactors, by the method of cell division. The effect of heterogeneous source distribution on the concentration distribution of the particles was investigated and compared with the known case of homogeneous source distribution. By a similar method, the temperature distribution in a solid body with granular structure, in which the heat sources are located in the grains, was calculated. This problem is analogous to the problem of the diffusion of particles with infinite life times through a solid with granular structure. The effect of the temperature distribution on the diffusion of particles was also investigated. Formulas for the practical application of the theory were derived and discussed with a numerically calculated example. (tr-auth)

24133 VAPOUR PRESSURE OF ISOTOPIC LIQUIDS. III. SOME CORRECTIONS TO PREVIOUS PAPERS. G. Boato, G. Casanova, G. Scoles, and M. E. Vallauri (Università, Genoa and Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo cimento (10), 20: 87-93(Apr. 1, 1961). (In English)

Some mistakes in previous papers in the derivation of $\ln p_A/p_B$ from the measured α are pointed out. As a consequence, the claimed linear dependence of $\ln p_A/p_B$ on $1/T$ for argon and neon is questioned. The corrected results agree with measurements carried out on liquid neon by a direct method. (auth)

24134 CHARGE AND CURRENT DENSITIES IN THE FARADAY DISC. R. Ingraham (New Mexico State Univ., University Park). Nuovo cimento (10), 20: 570-86(May 1, 1961). (In English)

The current distribution in a Faraday disc (homopolar generator) in investigated by solving approximately the magnetohydrodynamical equations. The current density streamlines are found to be spirals, with the possibility of a change in sense in the case where the magnetic field and the rotation axis are parallel. No solutions are found that show electrical neutrality. The induced charge density is proportional to $B\omega$ (B = applied magnetic field, ω = angular velocity of the disc). From a more fundamental approach, the Boltzmann equation for the Faraday disc is solved. (auth)

24135 A PROBLEM IN SHOCK WAVES. R. S. Mishra (Gorakhpur Univ., India). Nuovo cimento (10), 20: 605-9 (May 16, 1961). (In English)

Landau and Lifshitz (1959) have mentioned the following result: If two (or more) successive shock waves take a gas from state 1 to state 2 and from there to state 3, the transition from state 1 to state 3 can not, in general, be effected by the passages of any one shock wave. The object of this note is to obtain conditions for the transition from state 1 to state 3 to be effected by the passage of any one shock wave. (auth)

24136 X-RAY INDUCED CONVERSION IN THE ABSORPTION BANDS OF ADDITIVELY COLORED KCl. G. Baldini, L. Dalla Croce, and R. Fieschi (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan). Nuovo cimento (10), 20: 806-11(May 16, 1961). (In English)

Absorption spectra were obtained for additively colored KCl at −180°C after quenching, after irradiation with F light at room temperature, and after exposure to an x-ray beam. The maximum absorption coefficients of the various bands are shown as a function of exposure time. Similar experiments were carried out with crystals containing F, Z, and Z_2 centers. (L.T.W.)

24137 SHOCK-WAVE CURVATURE AT LOW INITIAL PRESSURE. Russell E. Duff and James L. Young, III (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 4: 812-15(July 1961).

The shape of the primary shock wave in a shock tube has been measured by recording the time of arrival of the shock in argon at an array of piezoelectric detectors located along a diameter of a 28.6-mm ID shock tube operated at an initial expansion chamber pressure of 0.34 mm Hg. The following conclusions were drawn from the results: (1) Shock-wave tilt was negligibly small under the conditions of these experiments (2) shock-wave curvature is independent of shock strength for shock Mach numbers from 1.8 to 6.3; (3) the shock-front shape is nearly spherical; (4) the axial extent or the bulge of the curved shock is approximately 1 mm. The axial extent of a shock in argon was also measured over the range of initial pressure from 0.1 to 20 mm Hg. It varies approximately as the inverse square root of the initial pressure. (auth)

24138 KINETIC THEORY OF MODERATELY DENSE, RIGID-SPHERE GASES. P. M. Livingston and C. F. Curtiss (Univ. of Wisconsin, Madison). Phys. Fluids, 4: 816-33(July 1961).

By successive partial integrations of the Liouville equation, the hierarchy of BBGKY equations are obtained. The series is terminated at the second equation by the introduction of a superposition approximation. A specialization to rigid spheres is made early in the treatment. Then, after defining a nonequilibrium pair correlation function, the first BBGKY equation is identified as an Enskog equation modified by the inclusion of a momentum-dependent correlation function in the collision integral. This equation and the second BBGKY equation completely determine the singlet distribution and pair correlation functions. An approximate solution to this pair of equations follows from the usual linearized perturbation expansion of the singlet distribution and pair correlation functions for the system near equilibrium. A set of five equations in the coefficients of the gradients are obtained, and the coupling between them is resolved by expanding these coefficients in powers of the number density. Because of the limitations imposed by the superposition approximation, only the first few terms in the density expansions are considered explicitly. The solutions to these equations and the resulting modifications of the transport coefficients are discussed. (auth)

24139 TRANSPORT PHENOMENA IN A FULLY IONIZED GAS CONFINED IN A STRONG MAGNETIC FIELD. Toyoki Koga (Univ. of Southern California, Los Angeles). Phys. Fluids, 4: 834-41(July 1961).

The distributions of ions and of electrons in the presence

of a strong magnetic field in the z direction are not assumed as being almost Maxwellian. Instead, $f^{(0)}$ $(c_x^2 + c_y^2, c_z, x \pm r c_y/c)$ is taken for the distributions in the zeroth approximation with respect to the ratio (Larmor radius r)/(free path length λ), and an iteration method is developed for solving the Boltzmann equation. First, defining the density of guiding centers of particles, $f^{(0)}$ is expanded into powers of $(r\,\partial f^{(0)}/\partial x)/f^{(0)}$. By coarse-graining the Boltzmann equation over one cycle of Larmor's gyration, equations of moments in the first approximation with respect to r/λ are derived. The simple mode of collision proposed by Bhatnagar et al. is assumed. A special case is studied in detail in order to compare the present theory with those of other authors who assume distributions to be almost Maxwellian. The agreement is good. The effects of drifts of guiding centers caused by the spatial nonuniformity of a magnetic field and/or by a static electric field in the presence of a uniform magnetic field are investigated. (auth)

24140 STABILITY OF A PLASMA BOUNDARY IN A MAGNETIC FIELD. B. Lehnert (Royal Inst. of Tech., Stockholm). Phys. Fluids, 4: 847-54(July 1961).

The stability of a plasma confined by a magnetic field has been discussed by Rosenbluth and Longmire in terms of particle orbits and the results applied to a plasma separated from vacuum by a sharp boundary which is rippled by a sinusoidal perturbation. This earlier theory is reconsidered and extended to include the effects of a finite density gradient. Drift motions along the boundary are also discussed for displacements comparable to and exceeding the wavelength of the perturbation. For small wavelengths it is found that the plasma is stable against small flute deformations not only for a magnetic field which is convex toward the plasma but also for a field which is concave toward the plasma, provided that the latter has a sufficiently strong gradient and that the density distribution is not too steep. Even in the unstable case the growth rate is reduced very much compared to the situation studied by Rosenbluth and Longmire. The result provides a possible explanation of the observed stability of the Van Allen radiation belts and in experiments with magnetic mirrors and rotating plasma devices. (auth)

24141 INTERACTION OF A STREAMING PLASMA WITH THE MAGNETIC FIELD OF A TWO-DIMENSIONAL DIPOLE. James Hurley (New York Univ., New York). Phys. Fluids, 4: 854-9(July 1961).

The interaction of a rarefied plasma stream and the magnetic field of a two-dimensional dipole has been investigated assuming that the domain of interaction between the field and plasma stream is small. The dipole field is found to be confined to a cavity in the plasma, with the plasma constituents being specularly reflected from the cavity wall. The shape of the cavity wall and the magnetic field inside have been determined. The interest of this problem lies in the analogous three-dimensional problem: the interaction between the solar wind and the earth magnetic dipole field. (auth)

24142 ON LANDAU DAMPING. John Dawson (Princeton Univ., N. J.). Phys. Fluids, 4: 869-74(July 1961). (MATT-54)

The problem of Landau damping of longitudinal plasma oscillations is investigated by dividing the plasma electrons into two groups. The first group is the main plasma and consists of all electrons with velocities considerably different from the wave velocity while the second group, the resonant electrons, consists of all electrons with velocities near the wave velocity. It is assumed that initially the main plasma has a wave on it while the resonant particles are undisturbed. It is shown that equating the gain in energy of the resonant particles to the loss in energy of the wave gives the correct Landau damping. Only first-order quantities are used in the analysis so that particle trapping which is a nonlinear effect is not involved. The validity of arguments which attribute Landau damping to particle trapping is discussed. The breakdown of the linearized theory and the Galilean invariance of the damping are also investigated. (auth)

24143 DETERMINATION OF HYDROMAGNETIC EQUILIBRIA. John M. Greene and John L. Johnson (Princeton Univ., N. J.). Phys. Fluids, 4: 875-90(July 1961).

Techniques for calculating hydromagnetic equilibria in toroidal systems which differ little from a uniform field are developed. The zeroth-order magnetic surfaces in these systems differ appreciably from concentric circular toroids. Care is taken to match onto reasonable external fields at the plasma boundary. Expressions for various equilibrium properties including the rotational transform, the net current on each surface, and the magnetic lines of force are obtained. As an illustration of the theory it is shown that the application of a particular field perpendicular to the plane of the torus reduces the distortion associated with the introduction of pressure into the system. (auth)

24144 ON THE MECHANISM OF EXPLODING WIRES. C. P. Nash (Univ. of California, Davis) and W. G. McMillan. Phys. Fluids, 4: 911-17(July 1961).

Experimental measurements are given for the energy input and shock wave arrival times for 10-cm No. 40 Cu wires exploded in air at an initial voltage of 9.25 kv. Two shocks in air are observed, one for each pulse before and after the dark pause. Pause duration measurements are also reported for wire explosions in gaseous He, N_2, O_2, Ar, and $CClF_3$ at 1 atm. Semiquantiative theoretical explanations are proposed for the increase in wire resistance which terminates the first current surge, and for the elapsed time (pause duration) before the vapor density of the expanding wire material declines sufficiently for reignition of the discharge. (auth)

24145 NEW ALLOTROPIC FORM OF He^3. A. F. Schuch and R. L. Mills (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Letters, 6: 596-7(June 1, 1961).

A transition in solid He^3 from hexagonal closest packing to face centered cubic structure is reported. Preliminary results show that the fcc phase is observed at around 19°K and 1700 atm, but not at 16°K and 1300 atm. (T.F.H.)

24146 DE HAAS-VAN ALPHEN EFFECT IN POTASSIUM. A. C. Thorsen and T. G. Berlincourt (Atomics International, Canoga Park, Calif.). Phys. Rev. Letters, 6: 617-18(June 1, 1961).

The amplitudes and periods of the de Haas-van Alphen oscillations in a K single crystal are measured, at about 1 to 2°K and in pulsed fields up to 160 kgauss. The results are compared with a free-electron model of metals. From the measured values, properties of the Fermi surface are inferred and an effective electron mass is calculated. (T.F.H.)

24147 CONSIDERATIONS ON THE γ-RAY DOSE MEASUREMENTS WITH THE CdS-CRYSTAL. Yoshio Onai and Goro Kusumoto (Hospital of Cancer Inst., Tokyo). Radioisotopes (Tokyo), 8: 142-8(Sept. 1959). (In Japanese)

The accuracy of a CdS crystal for the measurement of gamma radiation is studied. Co^{60} and Ra gamma sources are used. The crystal is compared with ionization cham-

bers and other CdS crystals. Measurements are made in water phantoms of varying thicknesses. (T.F.H.)

24148 THERMAL DIFFUSION OF BINARY GAS MIXTURES. S. C. Saxena and S. M. Dave (Atomic Energy Establishment, Trombay, India). Revs. Modern Phys., 33: 148-52(Apr. 1961).

Two types of theoretical approximations for the thermal diffusion factor of a binary gas mixture are studied. The special case is considered in which one gas is heavier and in trace concentration. Experimental and theoretical data are compared for binary mixtures of Xe^{133} with H_2, D_2, He, Ne, N_2, and Ar. (T.F.H.)

24149 TABLES OF BLACKBODY RADIATION FUNCTIONS. Mark Pivovonsky and Max R. Nagel. New York, The Macmillan Company, 1961. 523p. $12.50.

Tables of Blackbody Radiation Functions are a tabulation of Planck's radiation law and a number of related functions describing the radiant and luminous properties of ideal thermal radiators. A broad range of wavelengths and temperatures is covered. Included are discussions of the basic radiation functions, auxiliary tables, and eight primary tables of blackbody radiation functions. (L.N.N.)

24150 SELF-LUMINOUS LUMINESCENT SUBSTANCE AND METHOD FOR PREPARING SAME. (to Westo G.m.b.H. Fabrik für Chemische-Technische Erzeugnisse). British Patent 869,698. June 7, 1961.

A process for depositing titanium or zirconium, which absorbs gaseous tritium, on the surface of luminous particles is described. The tritium-absorbing metal is deposited on a luminous substance, such as a zinc-cadmium sulfide, in very thin layers which may be as little as only a few atoms thick; thus the layers are substantially transparent. The deposition is effected by cathode sputtering, by vapor coating in a vacuum, or by grinding luminous substance and the metal together in a ball mill. Tritium is then absorbed by the titanium or zirconium by chemical reaction in a heated container. The self-luminous substances are characterized by the fact that they do not give off any fast corpuscular rays. (N.W.R.)

24151 PRODUCTION OF U^{233}. (to United Kingdom Atomic Energy Authority). British Patent 873,171. July 19, 1961.

A method of producing U^{233} is described. The method consists of subjecting thorium to the action of neutrons, the majority of which have an energy of below one million electron volts. The reaction is terminated before the ratio of U^{233} to Th is one to 100 or when the ratio of U^{233} plus Pa^{233} to Th^{232} is between one to one million and one to ten thousand. The neutrons have an intensity of about 10^{17} neutrons per second, the majority of which have an energy below one million electron volts. (N.W.R.)

Astrophysics and Cosmology

24152 (AD-248362) CONVECTION AND DIFFUSION OF IONIZATION IN THE E-LAYER. H. Feshbach and F. Villars (Massachusetts Inst. of Tech., Lexington. Lincoln Lab.). Dec. 1, 1960. Contract AF19(604)-7400. 50p.

It was suggested that auroral backscattering of radio waves in the frequency range from 100 to 800 mc/sec is caused by the joint action of turbulence and the earth's magnetic field, which was assumed to produce small scale elongated irregularities of ionization lined up with the earth's field. Investigations were made of solutions of the equation for diffusion and transport of ionization in a weakly ionized turbulent plasma in the presence of a magnetic field. Because of space charge effects, the problem is non-linear in the ionization density $n(\vec{x},t)$. It is shown that in the linearized approximation, the effect of the magnetic field on turbulence does not lead to irregularities of a scale sufficiently small to explain the observed data. (auth)

24153 (AGARDograph-42) THE UPPER ATMOSPHERE ABOVE F2-MAXIMUM. PAPERS PRESENTED AT THE SYMPOSIUM OF THE IONOSPHERIC RESEARCH COMMITTEE AGARD AVIONICS PANEL, PARIS, FRANCE. H. Poeverlein, ed. (North Atlantic Treat Organization, Paris. Advisory Group for Aeronautical Research and Development). May 1959. 355p.

Twenty-nine papers are included; separate abstracts have been prepared for 24. Five papers were previously abstracted in NSA. (N.W.R.)

24154 (AGARDograph-42(p.3-9)) INTERPLANETARY HYDROGEN. Herbert Friedman (Naval Research Lab., Washington, D. C.).

Rocket measurements of ultraviolet light in the night sky reveal a glow attributable to resonantly scattered Lyman-α radiation. The source of this radiation may be interplanetary or geocoronal. On the former assumption the neutral atom concentration is estimated to be of the order of a few tenths of a particle per cc at a distance of one A.U. from the sun. New data on solar radiation below the Lyman limit permit an estimate to be made of the rate of ionization of neutral hydrogen. Electron bremsstrahlung from the Van Allen belts may be a source of x-rays in the 10 to 100 kev range detectable at altitudes below the belts. A flux of nearly 10^{-7} erg cm^{-2} s^{-1} is measured in the 20 to 50 kev range from a height of 100 km. The possibility of the source of this radiation being bremsstrahlung will be discussed. (auth)

24155 (AGARDograph-42(p.11-18)) IONIZATION ABOVE THE F2-PEAK, AS AFFECTED BY THE INTERPLANETARY GAS. Sydney Chapman (Alaska. Univ., College. Geophysical Inst. and High Altitude Observatory, [Climax], Colo.).

The atmospheres of the earth, the sun and other bodies are surrounded by gas that is nearly uniform in number density n and kinetic temperature T, over spaces much greater than those occupied by the atmospheres. This gas may be called the ambium of the atmosphere. In total it is much more massive than the atmosphere it encloses. The conditions in the ambium must powerfully affect the state of the outer atmosphere. In particular, there must be a continuous transition of the values of n and T between the ambium and the atmosphere. In the case of the earth, the sun and other hot stars, both the ambium and the outermost part of the atmosphere will consist of atomic hydrogen. The temperature of the ambium will determine whether this hydrogen and that of the outermost atmosphere are mainly ionized or neutral. The nature of the terrestrial ambium depends on the extension of the sun's atmosphere. This atmosphere is hot and highly ionized in its inner parts. At some radius not yet known, the solar atmospheric gas must become cool and neutral. The state of the earth's outermost atmosphere depends greatly on whether the earth lies in the ionized or the neutral part of the sun's atmosphere, or in the solar ambium. Evidence will be presented favoring the view that the earth's ambium consists of ionized solar atmospheric hydrogen. If this be so, the outermost part of the earth's atmosphere is likewise hot and ionized. It must enclose an extensive layer of mainly neutral atomic hydrogen. (auth)

24156 (AGARDograph-42(p.19-35)) THE STRUCTURE OF THE OUTER ATMOSPHERE INCLUDING THE ION DIS-

TRIBUTION ABOVE THE F2-MAXIMUM. Francis S. Johnson (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.).

Observations made of the ion distribution in the ionosphere indicate that the ion distribution up to 550 km is controlled not by diffusion but by changes in the recombination coefficient. This ion distribution control by recombination is concluded to be in probable agreement with diffusion theory. It is further concluded that the ion distribution above 550 km is controlled by diffusive equilibrium and not by recombination, although, above 550 km, further changes in the recombination coefficient do occur. Charge exchange reactions between oxygen ions and hydrogen atoms at an altitude near 800 km provide a source of the thermal protons which fill the magnetic field and provide a medium for the propagation of radio whistlers. The neutral hydrogen distribution around the earth is deduced from the night-time observation of hydrogen Lyman alpha radiation. The charge exchange reaction between oxygen ions and hydrogen atoms is nearly resonant, and the cross section for this reaction is probably large enough to provide the correct number of protons to explain the whistler propagation. The distribution of the protons around the earth, although diffusive in nature, is more affected by magnetic field than by gravity. When the magnetic field is considered, the proton distribution is found to be in excellent agreement with the whistler data. Thus, the ions responsible for whistler propagation are terrestrial in origin, and their source of ionization is the same as that for the F-region. (auth)

24157 (AGARDograph-42(p.37-45)) MOTIONS IN THE MAGNETOSPHERE OF THE EARTH. T. Gold (Cornell Univ., Ithaca, N. Y.).

The conditions determining the dynamical behavior of the ionized gas in the outer atmosphere of the earth are discussed. It is proposed to call this region in which the magnetic field of the earth dominates the 'Magnetosphere'. Van Allen's and other observations indicate that this zone reaches out to between five and ten earth's radii depending on the degree of magnetic disturbance. It is shown that the existence of an insulating layer at the base of this region, namely the non-ionized atmosphere, completely changes the type of control exerted by the magnetic field, allowing a class of motions to occur freely without the need to overcome any magnetic forces. The extent to which such motions may occur is discussed, and some of the indications from airglow and magnetic observations are mentioned. The theory predicts that at the level of the F2-layer and above most motions will show strict symmetry between the two base points of a magnetic line of force. (auth)

24158 (AGARDograph-42(p.47-54)) SUMMARY OF RESULTS ON THE TRAPPED PARTICLE ZONE. Robert Jastrow (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.).

From satellite and space probe measurements it is seen that the inner trapped particle zone contains a low energy component, probably electrons, and a penetrating component identified as protons with energies up to 1 Bev. According to Russian data the particles of the outer zone are electrons between 30 and 50 kev. The population of the outer zone varies by orders of magnitude with solar activity. It is almost certain that the outer zone is produced by particles coming from the sun, though the mechanism for transfer is not yet completely understood. The protons of the inner belt are produced by cosmic rays. Among the geophysical effects which may be caused by the particles of the outer zone are the aurora, and the high temperatures observed in the upper atmosphere at auroral latitudes. These are briefly discussed. (auth)

24159 (AGARDograph-42(p.55-65)) PROPERTIES OF THE UPPER ATMOSPHERE AND THEIR RELATION TO THE RADIATION BELTS OF THE EARTH. S. F. Singer (Maryland. Univ., College Park).

A new theory is developed which gives the distribution of density with altitude for a planetary exosphere in the absence of thermodynamic equilibrium. The results differ considerably from those calculated on the basis of the hydrostatic equation. To apply this theory to the earth's exosphere, the temperature of the base of the exosphere, which is located at 530 kilometers, is fixed by using satellite drag data between 500 and 1000 kilometers. A temperature of 1500° gives a reasonable fit to the rather sparse data and allows us to calculate the atomic oxygen distribution with altitude. An upper limit of about 10^6 hydrogen atoms per cm^3 at an altitude of 1000 km is set. However, the total density including the ionized component must be 10^{-19} g/cm^3 at 1000 km. The existence of a minimum between the two observed radiation belts, the so-called 'slot', is accounted for in terms of the breakdown of the adiabaticity of the magnetic moment of trapped particles. This same theory also allows one to make statements concerning the mean energy of the trapped protons in the inner radiation belt. The outer (auroral) radiation belt, which is centered at three earth radii, has a lifetime which is controlled primarily by the presence of a scattering atmosphere. From a theory which takes into account both energy loss and scattering, one can calculate the intensity contours for the quasi-equilibrium state. The initial injection of solar corpuscular radiation consists mainly of protons and electrons with velocities of 2×10^9 cm/sec. These 20-kev protons form a third and rather transient (~1 day) radiation belt at 4 to 8 earth radii; they account for most of the effects observed during magnetic storms. Their initial diamagnetic effects produce the 'reverse sudden commencement'. Their increase of upper atmosphere ionization accounts for the sudden commencement currents while their draft in longitude accounts well for the main phase of magnetic storms. In comparing various removal processes for the injected protons, the charge exchange is about 100 times more effective than atmospheric scattering. Using theoretical distribution for the hydrogen exosphere, the complete development of a magnetic storm as a function of time is calculated, including the distribution around the earth of trapped protons as well as their magnetic effects. (auth)

24160 (AGARDograph-42(p.67-82)) MEASUREMENT OF GEOMAGNETICALLY TRAPPED PARTICLES OF NATURAL AND ARTIFICIAL ORIGIN. Lew Allen, Jr. (Air Force Special Weapons Center, Kirtland AFB, N. Mex.).

The Air Force sounding rocket program in connection with the Argus experiment is described briefly. In this program, 13 research rockets were fired to altitudes of 800 km from the Eastern coast of the United States. The payload consisted of eight Geiger counters and measurements were made of charged particles trapped in the geomagnetic field where these particles were of natural and artificial origin. The observations are described and certain conclusions are drawn relating to the stability of trapped particle orbits. The measured angular distribution strongly supports the trapping theory. An additional flight of a similar counter package which was attached to a developmental flight of a long range ballistic missile is described. The ratio of energetic trapped electrons to heavy particles (protons) was measured at an altitude of 1000 km approximately over the island of Antigua. Some discussions of future planned experiments is given. (auth)

24161 (AGARDograph-42(p.83-94)) ATMOSPHERIC AND MAGNETIC LOSS MECHANISMS FOR GEOMAGNETI-

CALLY TRAPPED PARTICLES. Jasper A. Welch, Jr. (Air Force Special Weapons Center, Kirtland AFB, N. Mex.).

A theoretical formulation is made for the history of an artificial shell of geomagnetically trapped electrons resulting from low-yield nuclear detonations in the exosphere. The formulation considers the spatial distribution of trapped electrons along the magnetic field lines, the drift rate around the world, and the configuration of the resulting shell. Interactions of the shell with the atmosphere lead to an electron density decaying inversely with time from injection for times longer than a characteristic lifetime that is a function of altitude and electron energy. The electron flux is found to be very nearly confined to a plane perpendicular to the field direction after several characteristic lifetimes. Scattering by geomagnetic fluctuations is probably not an important loss mechanism for the artificial shell, but it may be important for the hard component of the natural trapped belt. The effect of the geomagnetic anomaly over the south Atlantic is described qualitatively. Jason rocket data and Explorer IV satellite data are compared with the theoretical results. (auth)

24162 (AGARDograph-42(p.95-111)) THE DETERMINATION OF THE DIRECTIONAL DISTRIBUTION OF CHARGED PARTICLES TRAPPED IN THE MAGNETIC FIELD OF THE EARTH. Russell D. Shelton (Army Ballistic Missile Agency, Redstone Arsenal, Ala.).

The anisotropy of the directional distribution of charged particle radiation is much in evidence in the Explorer IV records. The interpretation of these records required an understanding of the body motion of the satellite, the direction sampling of the radiation detectors, the accurate representation of the magnetic field of the earth, an accurate emphemeris, and a knowledge of charged particle motion in a magnetic field. The mathematical system for describing directional sampling of counters is formulated and applied in particular to Explorer IV. It is seen that the study of directional sampling is essential to a proper interpretation of the data. A sample calculation is provided to illustrate the details of interpreting count rate records from Explorer IV detectors. In the process, the method of determining the vectors defining the satellite motion is discussed. Finally, the basic theorems relating the spatial and directional distributions of the charged particle radiation are applied to a sample of data. (auth)

24163 (AGARDograph-42(p.113-38)) SOLAR FLARE PROTONS AND ELECTRONS AND THEIR INTERACTION WITH THE GEOMAGNETIC FIELD. John R. Winckler (Minnesota. Univ.; Minneapolis).

Since June 1957, on eight occasions, balloons floating at 30 km height have detected bursts of x-rays. The x-rays are detected by ionization chambers and counters. All cases are associated with strong aurorae near the zenith above the balloon. In many of these events, all-sky cameras from stations near Minneapolis showed the form of visible luminescence present. The x-rays originate from electrons of about 100 kv energy which are part of the auroral phenomenon and the x-rays are due to bremsstrahlung of these electrons in the high atmosphere. The ionization due to the x-rays and the electrons from which they originate is shown to produce changes in ionospheric conductivity associated with magnetic disturbances and increased absorption of extraterrestrial radio waves. The electrons may either be accelerated in the vicinity of the earth or be accelerated in the sun's atmosphere and be carried to the earth along with protons and other particles in the solar stream. They may be also temporarily a part of the recently discovered radiation belt surrounding the earth. During the above period of flight, on five occasions protons in the energy range 60 to 400 Mev were observed. These protons are time-associated with Class 3^+ solar flares. The flares are characterized by great intensity and by the emission of wide-spectrum radio noise storms. The protons are directly incident over the polar cap as shown by D-layer absorption of cosmic radio noise measured by Leinbach and Reid and called by them Type III events. The direct protons were measured by balloons at Ft. Churchill, Manitoba, and Fairbanks, Alaska. Some of the events were observed by balloons at Minneapolis, and in these cases the protons arrived during a geomagnetic disturbance. The proton energies at Minneapolis are below the normal Störmer cutoff values, and one must assume that considerable distortion of the geomagnetic field occurs by action of the solar flare plasma. The flare protons either remain trapped in this plasma during its transit from the sun, or diffuse out of the corona and travel in a channel established by the flare. (auth)

24164 (AGARDograph-42(p.151-63)) VHF RADIO WAVE ABSORPTION IN NORTHERN LATITUDES AND SOLAR PARTICLE EMISSIONS. Harold Leinbach and George C. Reid (Alaska. Univ., College. Geophysical Inst.).

The IGY program of ionospheric absorption measurements in northern latitudes has shown that abnormal absorption events can be divided into three distinct classes, here referred to as Type I, II, and III absorption respectively. The properties and interpretation of Type III absorption, which probably has its origin in atmospheric ionization caused by protons emitted from the sun at the time of a solar flare, are described. Evidence is presented which indicates that these protons travel from the sun to the earth along curved paths, and the curvature is shown to be of the order of magnitude which would be expected if the path were defined by magnetic field lines carried out from the sun by particles of much lower velocity. The interpretation of the long duration of these events is discussed, and some estimates of the energy of the protons, and of their number density in interplanetary space are made. (auth)

24165 (ACARDograph-42(p.175-81)) ON THE INTERPRETATION OF VERY HIGH AURORAE. A. Omholt (Oslo. Universitetet).

The known facts about aurorae occurring in the upper part of the ionosphere are discussed. It is concluded that it is difficult to deduce any precise quantitative information about the upper atmosphere from the available observational data, but that these data are not in disagreement with rocket and satellite results. Some estimates are made of the rates of ionization in the F-region of the ionosphere due to aurorae, and of the density in the beam of primary particles. It is suggested that monochromatic observations of very high auroral rays may give information on drifts and turbulence in the F-region. (auth)

24166 (AGARDograph-42(p.183-200)) OPTICAL, ELECTROMAGNETIC AND SATELLITE OBSERVATIONS OF HIGH-ALTITUDE NUCLEAR DETONATIONS. PART I. Philip Newman (Air Force Cambridge Research Center. Propagation Sciences Lab., Bedford, Mass.).

Ground instrumentation was set up in the detonation area of the Argus tests and at the geomagnetic conjugate area near the Azores to observe auroral effects that might be produced by the entry of some of the electrons into the atmosphere and to observe any whistlers, ELF waves, or magnetic effects which might be produced by the explosion. The nominal height of the detonations was 480 km. The nuclear bombs were of approximately 1 kiloton. Visual auroras were observed in the detonation area in all three events.

These were also observed on a 27 Mc/s radar. In the conjugate area, a brilliant aurora was observed in the third event. The ELF receiver, employing loops, obtained strong signals in the second and third events. The frequency was approximately 1 c/s. A path along the magnetic field line would require a propagation velocity of about 2000 km/s. Much smaller signals at a similar frequency were recorded in Arizona utilizing a large loop. A sporadic E cloud moving eastward was observed on ionosondes in the vicinity of the Azores shortly after the third detonation. (auth)

24167 (AGARDograph-42(p.211-21)) A MODEL OF THE F-REGION ABOVE $h_{max}F2$. J. W. Wright (National Bureau of Standards. [Boulder Labs.], Boulder, Colo.).

A simple Chapman model (scale height 100 km) of the ionosphere above the peak of the F-region is found to be in good agreement with the few observed profiles of this region. The ratio of the above-peak electron content implied by the model, to below-peak electron content, is found to vary from about 2.8 to 4.0. The model is used to conjunction with electron density profiles observed from the ground to construct meridional cross-sections along the 75° W geographic meridian. (auth)

24168 (AGARDograph-42(p.243-62)) THE FARADAY EFFECT AND SATELLITE RADIO SIGNALS PROPAGATED THROUGH THE IONOSPHERES. W. T. Blackband, B. Burgess, I. L. Jones, and G. J. Lawson (Gt. Brit. Royal Aircraft Establishment, Farnborough, Hants, England).

The total ionospheric electron content between the ground and a radio transmitter on an artificial earth satellite can in certain circumstances be determined from the Faraday fading effects. A theory of the method is presented together with a discussion of the interpretation of fading records. Experimental data are given, and compared with those obtained by other methods. (auth)

24169 (AGARDograph-42(p.263-70)) DENSITE ELECTRONIQUE AU-DESSUS DE F-MAXIMUM, DEDUITE DE L'EMISSION DES SATELLITES. (Electron Density Beyond F-Maximum, Determined by the Emission of Satellites). E. J. Vassy (Paris. Université).

The interesting method proposed by Alpert and his associates for the determination of the electron density beyond F-maximum is discussed. This method is based on the investigation of the refraction at the moment of radioelectric 'rise' or 'setting' of an artificial satellite. Alpert assumes an exponential decrease of the electron density beyond F-maximum. As a consequence of data provided by Pioneer III (van Allen), this assumption must be restricted to altitude intervals for which it can be verified experimentally. It is suggested that: the refraction be determined by experimentation, ionospheric soundings be used up to F-maximum as proposed by Alpert, and the experimental data for various altitudes of the satellite be used with consideration be given to a law of distribution to be determined solely between the altitude of the satellite and that of F-maximum. (auth)

24170 (AGARDograph-42(p.271-84)) HIGH-LATITUDE STUDIES OF F-LAYER AND OUTER ATMOSPHERE IONIZATION. L. Owren, H. Bates, and J. Pope (Alaska. Univ., College. Geophysical Inst.).

Oblique sweep-frequency backscatter soundings of the auroral zone ionosphere show a prevalence of direct scatter echoes from the F-layer. The two most common echoes are identified as respectively weak backscatter from random collections of field-aligned irregularities distributed over a large region of the ionosphere and strong backscatter from isolated clouds of field-aligned irregularities. The first type of backscatter echo shows the range-frequency variation expected for a least-time focussed mode. The second type echo has essentially a constant range over the observed frequency interval. The method of observation and analysis permits definite conclusions about the F-layer structure below and up to the F2-peak only, but it is probable that the observed irregularities extend through the maximum into the higher strata. The electron density distribution above the F2-peak is determined by Doppler-shift recordings of the two tracking signals from the Russian satellite 1957β. Profiles are available for both a magnetically quiet and a disturbed period. A number of whistler trains occurring on 19 March 1959 are used to determine the electron density as a function of distance from the earth in the region where the field-lines cross the geomagnetic equator plane. The whistler trains recorded during a 6-hour period showed striking similarities indicating persistence of structural details in the ionization along the propagation paths. In the analysis the electron density was assumed to vary as the inverse cube of the distance from the earth's center. The values obtained from the various whistler trains agree within the experimental errors. The results also indicate that the actual decrease in electron density with distance is slightly faster than the assumed inverse cube law. (auth)

24171 (AGARDograph-42(p.285-9)) IONOSPHERIC ELECTRON CONTENT FROM REFRACTION MEASUREMENTS ON COSMIC RADIO SOURCES. M. M. Komesaroff and C. A. Shain (Australia. Radiophysics Lab., Chippendale, New South Wales).

A technique is described by which the total electron content of the ionosphere, including the upper F-region, is measured. A number of position measurements are carried out on discrete sources of cosmic radio emission, using a pencil beam aerial system of the Mills Cross type operating at 20 Mc/s. From the known high-frequency positions of the sources the refraction components, in declination and right ascension, are calculated for a large number of cases. On the basis of a new theoretical analysis of the problem, the refraction measurements are combined with simultaneous ionospheric sounding data from a number of stations and it is possible to assess the effective thickness of the ionosphere. The theoretical analysis takes into account the first-order effects of departures from spherical symmetry. It is shown that previous treatments which neglect horizontal gradients are quite inadequate, because the refraction components due to these gradients are frequently very much greater than the refraction to be expected from a strictly spherical model. (auth)

24172 (AGARDograph-42(p.291-300)) RADAR STUDIES OF THE CISLUNAR MEDIUM. PART I: THEORETICAL. V. R. Eshleman, R. C. Barthle, and P. B. Gallagher (Stanford Univ., Calif. Radio Propagation Lab.).

The ionized medium between the earth and the moon is being studied by means of lunar radar echoes. Of prime interest is the ion density beyond the earth's ionosphere, at distances (several to 60 earth radii) where the interplanetary gas may be dominant. There are several techniques based upon hf (3 to 30 Mc) moon echoes for measuring the total integrated ion density. The ionospheric part may be determined separately and subtracted from the total. The moon's radar range exceeds the true range because of group retardation, which is a measure of integrated ion density. (The retardation varies as f^{-2}, being 250 μs at 20 Mc for an average cislunar density of $10^9/m^3$). Range measurements giving density would require high peak power (for pulse ranging) or high equipment stability (for cw ranging); furthermore, the true lunar range is not known accurately. The full average-power capability of an hf

transmitter can be used without regard to high stability or precise lunar range. In one method, three equally-spaced frequencies are sent in the form of an amplitude modulated wave. Thus a reference quantity is sent with the measuring quantities. The relative phases, and hence the character of the modulation, are changed due to dispersion in the cislunar medium. For example, a direct measure of the integrated ion density would be the value of the modulating frequency at which an amplitude modulated signal is changed to a frequency modulated echo. In another method an hf and a vhf transmitter are modulated by the same audio signal. The difference of the audio phase in the simultaneously-recorded echoes should be a measure of the integrated ion density. Doppler frequency shifts and the earth's magnetic field cause only slight difficulties. However, path splitting, ion 'blobs', and lunar surface irregularities possibly could affect the waves more than does the integrated ion density. The measurements would then yield information about the temporal and spatial variations of the cislunar medium. (auth)

24173 (AGARDograph-42(p.301-12)) RADAR STUDIES OF THE CISLUNAR MEDIUM. PART II: EXPERIMENTAL. P. B. Gallagher, R. C. Barthle, and V. R. Eshleman (Stanford Univ., Calif. Radio Propagation Lab.).

The radar used in the moon-echo experiments includes a 50-kw linear amplifier at 23.1 Mc, connected to a 2000-foot broadside array consisting of 48 four-element Yagi antennas. For the dispersion measurements, three separate receivers, each with an IF bandwidth of 100 cps, are used for the three frequencies. The three echo signals are translated to the same audio frequency for phase comparisons. Measurements are made using 100 kc, 50 kc, 10 kc, and 5 kc modulating frequencies. Dispersion causes a 90° increase in phase lead of the carrier relative to the sum of the two sidebands for an average cislunar ion density of $3 \times 10^9/m^3$ at 100 kc and $1.2 \times 10^{12}/m^3$ at 5 kc. Large phase differences are measured at each of the modulating frequencies, and the phase differences change with time. The average ion density is as large or changes as rapidly as these measurements would indicate, based on dispersion. Thus it appears that the relative phases are controlled by path splitting, and time and space variations in the medium, or lunar libration and surface irregularities. If path instabilities affect the CW measurements, the echo pulse shape and position would be distorted and would change with time. Early studies of hf moon echoes led to the conclusion that the moon was a rough reflector, while more recent studies at vhf and uhf indicate that it is relatively smooth. It may be that the moon is smooth, but at hf the cislunar medium is rough. (auth)

24174 (AGARDograph-42(p.313-19)) MEASUREMENTS OF IONOSPHERIC ELECTRON CONTENT BY THE LUNAR RADIO TECHNIQUE. Siegfried J. Bauer and Fred B. Daniels (Army Signal Research and Development Lab., Fort Monmouth, N. J.).

Measurements of the Faraday rotation of lunar radio echoes on a frequency of 151 Mc/s are used to determine the time variation in the total ionospheric electron content. Absolute values of ionospheric electron content are determined from these measurements in conjunction with information on the electron content below the F2-peak computed from vertical-incidence sounding data. Diurnal, day-to-day, and seasonal variations in the total electron content are presented. The ratio $n_a : n_b$ of the number of electrons above the F2-peak to that below is found to be in the order of four to five during three summer nights (June) before sunrise and about equal to three after sunrise. For two days in November the ratio $n_a : n_b$ is found to be equal to about three both before and after sunrise. Possibilities of inferring other characteristics of the upper ionosphere from observed variations in the total electron content are briefly discussed. (auth)

24175 (AGARDograph-42(p.321-2)) REMARK CONCERNING THE CHARGE OF A SATELLITE. K. Rawer (Germany. Deutsche Bundespost. Ionosphären-Institut, Breisach).

The electrical potential of a satellite depends on the ion and electron density found on its orbit. While the thermal velocity of the electrons is large compared with the satellite velocity, the contrary is true for ions (at least for 0+). Thus ions are effectively captured only on the front side of the vehicle, whereas electrons with their high velocities reach it from both sides. The (negative) equilibrium potential is obtained with equality of both currents. It depends essentially on the contribution of fast electrons. Another important point is the photoeffect of solar radiation. Using some approximations for the intensity distribution in the solar spectrum on one side and for the efficiency of the photoeffect on the other side. The photocurrent was calculated as a function of the satellite potential. This current, which is to be added to the ion current, becomes important when the electron density is 10^{11} m^{-3} or smaller. In this case a measurable difference of equilibrium potential must exist between the sunlit and the shadow part of the orbit. With an electron density of 10^{10} m^{-3} the potential should be positive in the sunlit part and negative in the shadow (by some volts). The conditions in the range of positive potential are presented. From the calculations it follows that the photocurrent is decisive for the potential, provided that the electron density is not too high; that the change between day and night might be important; and that observation of the potential would be of interest for various reasons, especially as it is highly sensitive to the proportion of high energy electrons. (auth)

24176 (AGARDograph-42(p.323-32)) HYBRID WHISTLERS AND THE PROBLEM OF THE WHISTLER PATHS. R. A. Helliwell (Stanford Univ., Calif. Radio Propagation Lab.).

Whistlers frequently exhibit many well-defined components which are thought to result from the existence of separate paths of propagation. It is suggested that such paths might be defined by columns of enhanced ionization which are aligned with the earth's magnetic field and which reach from one hemisphere to the other. Another possibility is that whistler energy is permitted to emerge from the ionosphere only at specific locations where conditions are favorable. A test to differentiate these two models would be to excite whistler paths simultaneously in opposite hemispheres from the same source. At a receiver in either hemisphere the result would be the superposition of long and short whistlers—a hybrid whistler. The dispersion ratios of a hybrid whistler and its echoes would be 1 : 2 : 3 : 4 : 5 etc. if the paths were the same for both directions of propagation. A search of records from the IGY Whistler-West project has revealed several examples of what appear to be genuine hybrids. Their existence argues strongly for the field-aligned column hypothesis of whistler paths. The application of this hypothesis to the calculations of electron density in the outer ionosphere is discussed. (auth)

24177 (AGARDograph-42(p.345-54)) TRANSPARENCY OF THE IONOSPHERE AND POSSIBLE NOISE SIGNALS FROM HIGH ALTITUDES AT EXTREMELY LOW FRE-

QUENCIES. H. Poeverlein (Air Force Cambridge Research Center, Bedford, Mass.).

Propagation of extremely low frequencies in the ionosphere is studied on the basis of a recently developed wave theory with inclusion of the effect of ions. Only vertically traveling waves are considered. The ordinary and the extraordinary wave appear separated. The ionosphere is found to be transparent for the extraordinary wave generally, for the ordinary wave only at frequencies below the gyroresonance frequency of the ions. At the lowest frequencies the waves become hydromagnetic or Alfvén waves. The transparency of the lower ionosphere is only partial, but a resonance effect at a few hundred cycles should particularly improve it for downcoming extraordinary waves at this frequency. Under the idealizing assumptions made in the following, the refractive index of the ordinary wave becomes infinite at the gyrofrequencies of the ions present. It has zeros between successive infinities. The infinities indicate the possibility of gyroresonance oscillations, which may be excited by various processes, especially at high altitudes where the collision frequency is low. Zero refractive index in a certain space may allow resonance oscillations when high values of the refractive index prevail in the surroundings. Furthermore, spaces with stronger ionization are capable of resonance. Noises produced in high altitudes by any of these resonance effects will be propagated through the transparent ionosphere down to the ground. Some of the noise signals observed at extremely low frequencies probably have originated from gyroresonance at high altitude. (auth)

24178 NUCLEAR REACTIONS IN COLLISIONS OF GALAXIES. S. N. Milford (St. John's Univ., Queens, New York). Astrophys. J., 130: 465-8(1959).

When two galaxies collide, the interaction of their interstellar gases causes nuclear reactions to occur. Order-of-magnitude calculations show that the effect of these reactions is negligible during the early stages of the collision. However, if a sufficiently compressed gas develops in the later stages of the collision, the calculations show that discrete gamma radiation from the collision should be observable above the earth's atmosphere. (auth)

24179 MATTER, ANTI-MATTER, AND GRAVITATION. W. F. G. Swann (Bartol Research Foundation, Philadelphia). Astrophys. J., 133: 733-7(May 1961).

An extension is presented to include matter and anti-matter in the suggestion that gravitation may be understood by supposing that the attraction between unlike elementary charges exceeds the repulsion between like charges by a small amount. The extension considered is one in which the forces between charged particles are of normal form multiplied by a factor $(1 + \epsilon)$ for cases where one and only one of the particles is a heavy particle (proton or anti-proton), while the normal form applies to all other cases. The hypothesis leads to the conclusion that like pieces of matter attract and unlike pieces of matter repel, where like and unlike are to be understood in the sense of ordinary matter and anti-matter. The bearing of the general theory of relativitv upon the question is also discussed. (auth)

24180 AN ANALYSIS OF R. A. LYTTLETON AND H. BONDI'S THEORY OF "THE PHYSICAL CONSEQUENCES OF A GENERAL EXCESS OF CHARGE." W. F. G. Swann (Bartol Research Foundation, Philadelphia). Astrophys. J., 133: 738-54(May 1961).

A theory of relative galactic motion is described that leads to a velocity proportional to the distance from a given origin. The theory is based on a spontaneous creation of charged matter, in which the positive charge created slightly exceeds the negative. The problem is formulated within the framework of field theory and general relativity theory. It is shown that the relativistic treatment cannot be regarded as a generalization of the field theoretical treatment. (T.F.H.)

24181 EQUILIBRIUM MODELS FOR STARS WHICH DERIVE ENERGY FROM HELIUM-BURNING. I. STARS COMPOSED OF PURE HELIUM. John P. Cox and R. Thomas Giuli (Cornell Univ., Ithaca, N. Y.). Astrophys. J., 133: 755-63(May 1961).

Equilibrium models are constructed for pure helium stars that derive all their energy production from the Salpeter triple alpha reaction. The Cowling model with an electron-scattering envelope is adopted as the basic model. Radiation pressure and degeneracy are both neglected. Integrations on an electronic computer yield the constants of the model to greater accuracy than previously reported. The assumptions of negligible radiation pressure and degeneracy are shown to limit the masses for which the models are physically valid to the range $0.5 \leq M \leq 9$ (solar mass units). The assumption of pure electron scattering is also found to be fairly good for all masses considered. The helium-burning "main sequence" derived runs roughly parallel to the normal population I main sequence and is displaced toward higher effective temperatures, for given luminosity, by a factor of about 4 relative to the population I main sequence. The results are compared with those obtained on the basis of the standard model. (auth)

24182 EQUILIBRIUM MODELS FOR STARS WHICH DERIVE ENERGY FROM HELIUM-BURNING. II. HELIUM STARS WITH HYDROGEN-RICH ENVELOPES. John P. Cox and Edwin E. Salpeter (Cornell Univ., Ithaca, N. Y.). Astrophys. J., 133: 764-80(May 1961).

Models are constructed for helium-burning stars which possess a hydrogen-rich envelope in radiative equilibrium. These inhomogeneous models are obtained from the models constructed for homogeneous, pure helium-burning stars by use of an approximation method. This method is applicable only if the fractions of the total mass and total energy production contained in the envelope are small. The bolometric luminosity is assumed to be the same as that of a homogeneous, pure helium star of the same mass M. If the hydrogen abundance X' (by weight) in the envelope is near unity, then the presence of a hydrogen-rich envelope containing a mass fraction Q' of only 0.1 is found to increase the radius of the star by a factor of about 10. The factor by which the radius is increased is independent of mass M but increases rapidly with both X' and Q'. The present approximate models are in good agreement with more accurate ones constructed for larger values of Q'. Assuming the O-type subdwarf HZ 44 to be represented by a model of this type, its mass and absolute bolometric magnitude can be estimated. It is found that $M \approx 0.5\ M_{sun}$, $M_{bol} \approx +0.8$, and $Q' \approx 0.05$. The possible evolutionary significance of the present models and their relation to the observed properties of the nuclei of planetary nebulae and of the hot subwarfs are discussed. The approximation method is described in general form and is applied to pure helium star models to show that inclusion of the free-free contribution to the opacity in the outer layers of the pure helium models would increase their radii by no more than 2 or 3 per cent. (auth)

24183 SUDDEN EXPANSION OF THE CORONA FOLLOWING A LARGE SOLAR FLARE AND THE ATTENDANT MAGNETIC FIELD AND COSMIC-RAY EFFECTS. E. N. Parker (Univ. of Chicago). Astrophys. J., 133: 1014-33 (May 1961).

It is shown from the hydrodynamic equations that the 4×10^{6}°K temperatures observed in the solar corona after a large solar flare can produce a hydrodynamic blast wave, moving out through interplanetary space with velocities of 1500 km/sec and densities from a few times 10^{2} to 10^{5}/cm^{3} at the orbit of earth. It is suggested that this hydrodynamic explosion of the enhanced corona is the accelerating mechanism for the plasma clouds or enhanced solar corpuscular emission responsible for the geomagnetic storm, the cosmic-ray decrease, the low-latitude aurorae, etc., observed at earth a day or two following large solar flares on the visible hemisphere of the sun. The interplanetary magnetic field is computed in the blast wave, assuming an initial quiet-day solar wind of a few hundred km/sec ahead of the wave. The spiral field of the quiet-day wind is sheared by the blast wave, and its density, of the order of 2×10^{-5} gauss at the orbit of earth, may be increased to 5×10^{-4} gauss or more for a period of several hours. The effect of the outward-sweeping magnetic shear in the blast wave is to decrease the cosmic-ray intensity, by as much as 40%, in the inner solar system behind the blast wave. The onset of the decrease has a characteristic time of several hours, and the relaxation many hours or days. The energy dependence of the decrease may go inversely with particle rigidity, or it may be flatter, depending on the details of the magnetic configuration in and around the blast wave. Thus the cosmic-ray decrease produced by the blast wave is identical with the Forbush-type cosmic-ray decrease observed in association with enhanced solar corpuscular radiation. (auth)

24184 ON THE ORIGIN OF COSMIC MAGNETIC FIELDS. H. Alfvén (Royal Inst. of Tech., Stockholm). Astrophys. J., 133: 1049-54(May 1961).

As an alternative to the "self-exciting dynamo," a non-stationary model for cosmic magnetic fields is discussed. The model is based on a plasma effect. The suggested mechanism is the following: In an original poloidal field, hydrodynamic motion produces a toroidal field. When this has reached a certain strength, it becomes unstable. A kink instability changes the field configuration in such a way that an amplified poloidal magnetic field is produced. The process is then repeated. In order to start the field amplification, a very simple pattern of motion is needed, which may easily be produced both in the interior of planets and stars and in interstellar matter. (auth)

24185 INTERPENETRATION OF TWO IONIZED GAS CLOUDS. J. N. Tandon (Univ. of Delhi). Indian J. Phys., 35: 193-8(Apr. 1961). (In English)

Collisions of two ionized gas clouds are considered. It is shown that counter streaming effects, in general, unstable. The double stream will form small clouds of space charge at the expense of streaming energy of the clouds. These small clouds are responsible for geomagnetic storms and for the generation of radio noise from colliding galaxies. (auth)

24186 FRONTIERS OF ASTROPHYSICS. Bengt Strömgren (Inst. for Advanced Study, Princeton, N. J.). [Paper No.] 1733-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 11p.

Advances in astrophysics brought about by developments in optical and radio astronomy, and by discoveries in nuclear physics, are studied and reviewed. The relations between the ages of stars and their radii, luminosities, structures, masses, and chemical compositions are outlined. Uses of orbital observatories to study the stars are discussed. Properties of interstellar matter are considered. (T.F.H.)

Cosmic Radiation

24187 (LAMS-2526(p.172-85)) RADIATION DOSE RATES ABOVE THE ATMOSPHERE. III. FLIGHT RESULTS AND NEW DESIGN FOR A TISSUE EQUIVALENT IONIZATION CHAMBER. M. A. Van Dilla, J. H. Larkins, R. D. Hiebert, and J. A. Sayeg (Los Alamos Scientific Lab., N. Mex.).

Design features are described of a modified tissue-equivalent ion chamber for measurements of radiation dose rates above the atmosphere. The units have been tested in 4 high-altitude balloon flights, 2 Atlas flights, and in Blue Scout 1, a large solid-fuel rocket. The status of flights made to date are tabulated. The most significant data received and analyzed so far come from the second Atlas flight. A preliminary reduction of the data on dose rate versus trajectory is plotted. The ion chamber readings are due entirely to Van Allen radiation. Features of the dose rate-latitude curve are discussed. Response to the high energy protons of the inner Van Allen belt was about as expected. Use of the ion chamber in shots planned for the future is discussed. (C.H.)

24188 (TID-13125) PROGRESS REPORT ON [NEUTRINO PHYSICS AND COSMIC RAYS]. (Case Inst. of Tech., Cleveland. Nuclear Physics Lab.). [1960?]. Contract AT(11-1)-818. 14p.

The large liquid scintillation detector constructed to study the $\bar{\nu}$ + p and $\bar{\nu}$ + d reactions is described. The lifetime for protons bound in nuclei was determined to have a lower limit of 10^{27} years. The limit of neutrinos produced by cosmic rays in the atmosphere is set at 10^{2} times the predicted value of 1 count per 2 years. The energies of cosmic muons reaching the underground depth of 1925 ft were found to be in excess of 100 Bev. The status of the cosmic ray program is outlined and some preliminary data on the analysis of the TD stack presented. (D.L.C.)

24189 CHARACTERISTICS OF THE VAN ALLEN RADIATION ZONES AS MEASURED BY THE SCINTILLATION COUNTER ON EXPLORER VI. Alan Rosen and Thomas A. Farley (Space Tech. Labs., Inc., Los Angeles). J. Geophys. Research, 66: 2013-28(July 1961).

A scintillation counter responding principally to direct electrons was flown on the Explorer VI earth satellite in an elliptical orbit extending to 48600 km. The instrument measured fluxes of electrons above 200 kev and protons above 2 Mev. After a week of magnetically quiet observations, a geomagnetic storm occurred, and an immediate increase in the counting rate of this instrument was detected; other radiation instruments showed a decrease in counting rate at this time. Gross fluctuations in particle intensity were observed at the edge of the outer zone of the Van Allen radiation belt during the storm, and these fluctuations are closely related to simultaneous geomagnetic activity. The increased particle intensity in the outer zone declined quite slowly after the storm until the next period of magnetic activity about two weeks later. A detailed summary of the observations made by the scintillation counter during the period of data reception from the satellite is presented. (auth)

24190 RING CURRENTS IN THE REGION OF THE VAN ALLEN RADIATION BELTS. R. Fiebig and H. Voelcker (Christian-Albrechts-Universität, Kiel). J. Geophys. Research, 66: 2262(July 1961).

By measuring the earth's magnetic field in the region of the Van Allen radiation belts, clear differences between the calculated dipole field and the observed values were found. The radiation belts were treated as a plasma contained by the earth's magnetic field. In a simple model sufficient agreement was found between the calculated and observed values of the current strength. The drift velocity was calculated from Strömer's theory. The outer anomaly may be interpreted by the diamagnetic effect. A model of an idealized radiation belt with monoenergetic particles, constant density within, and an ideal slope at the outer boundary of the belt was used. The theoretical approximation gave a current of 3×10^4 amp. The corresponding current, calculated from the observed magnetic anomaly, was greater by one order of magnitude. (P.C.H.)

24191 A CLOUD CHAMBER STUDY OF HIGH ENERGY NUCLEAR INTERACTIONS OF COSMIC RAY PARTICLES. I. A POSSIBLE EVIDENCE OF SUCCESSIVE COLLISIONS IN CARBON NUCLEI. Iaso Kita (Kobe Univ., Japan). J. Phys. Soc. Japan, 16: 1099-1106(June 1961). (In English)

In order to study the high energy nuclear interactions of cosmic ray particles, a momentum cloud chamber was operated 2740 m above sea level, and about ten thousand pairs of stereoscopic pictures of such events were taken. Selected showers were transformed to the c.m. system of the collisions to obtain the intrinsic features of the nuclear interactions. In the energy range around 100 Bev for the incident nucleons, the successive collision model in carbon nuclei, rather than the complete collision model, seems to be consistent with the experimental evidence. (auth)

24192 A CLOUD CHAMBER STUDY OF HIGH ENERGY NUCLEAR INTERACTIONS OF COSMIC RAY PARTICLES. II. RESULTS OF SINGLE NUCLEON-NUCLEON INTERACTIONS. Goro Fujioka (Kobe Univ., Japan). J. Phys. Soc. Japan, 16: 1107-14(June 1961). (In English)

Thirty possible nucleon-nucleon interactions of primary energies around 100 Bev observed in a magnet cloud chamber were analyzed in their center of mass systems. The angular distribution of secondary particles was nearly isotropic. The average values of energy and momentum for the products were 350 Mev and 220 Mev/c, respectively, the rms deviations about mean values being 225 Mev and 160 Mev/c. The energy spectrum could be represented as $E^{*-2}dE^{*}$. The inelasticity of interactions had a tendency to decrease with increasing primary energies. The average inelasticity in the center of mass system was 0.27 ± 0.05. All interactions had almost an equal number of shower particles in the forward and backward directions in the center of mass system. (auth)

24193 VERIFICATION AT 27 GeV OF A FORMULA FOR THE DETERMINATION OF THE PRIMARY ENERGY OF JETS. A. Barbaro Galtieri (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome), G. Baroni, A. Manfredini, C. Castagnoli, C. Lamborizio, and I. Ortalli. Nuovo cimento (10), 20: 487-97(May 1, 1961). (In English)

Proton interactions in nuclear emulsions at 27 Bev are analyzed in order to verify at this energy the validity of the formula $\lg\gamma_c = \langle \lg|\mathrm{ctg}\ \theta| \rangle$. Agreement between expected and experimental values is found for interactions with ≤4 heavy prongs and multiplicities ≥4. The correction to be introduced under the hypothesis of a pion spectrum due to statistical theory is discussed, as well as the dispersion of the value of $\lg\gamma_c$ obtained. (auth)

24194 LATITUDE-DEPENDENCE OF A FORBUSH TYPE DECREASE. Lekh Vir and P. S. Gill (Gulmarg Research Observatory, India). Nuovo cimento (10), 20: 498-501(May 1, 1961). (In English)

The latitude dependence of a cosmic ray intensity decrease is determined. It is shown that the relative amplitude does not flatten beyond the latitude knee. It, rather, keeps increasing far beyond the knee. It is also seen that the relative amplitude is not symmetrical around the geomagnetic equator. (auth)

24195 PRODUCTION OF ATMOSPHERIC NEUTRONS BY SOLAR γ RAYS. K. Maeda (Univ. of Nebraska, Lincoln). Nuovo cimento (10), 20: 587-90(May 1, 1961). (In English)

It is shown that atmospheric neutrons may be produced by solar γ ray reactions (γ,n) on O^{16} and N^{14}. It is assumed that these γ rays exist and that they can have maximum energies between 340 and 1700 Mev. The intensity of the neutrons is calculated as a function of atmospheric depth, and compared with balloon observations. (T.F.H.)

24196 MESON PRODUCTION IN NUCLEUS-NUCLEUS COLLISIONS. G. Alexander, J. Avidan, A. Avni, and G. Yekutieli (Weizmann Inst. of Science, Rohovoth, Israel). Nuovo cimento (10), 20: 648-61(May 16, 1961). (In English)

Nucleus-nucleus collisions at cosmic-ray energies are described in terms of nucleon-nucleon collisions. The average multiplicity for different types of reactions is predicted and compared with experimental observation. (auth)

24197 HIGH-ENERGY INTERACTIONS OF A HEAVY PRIMARY IN EMULSION. G. Biczó, G. Bozóki, E. Fenyves, and E. Gombosi (Central Research Inst. of Physics, Budapest and Roland Eötvös Univ., Budapest). Nuovo cimento (10), 20: 662-6(May 16, 1961). (In English)

Two successive high-energy interactions of a heavy primary cosmic ray particle in emulsion were analyzed. The differential angular distribution of shower particles generated does not show any significant deviation from the distribution predicted by the hydrodynamical theory. (auth)

24198 ISOTOPIC COMPOSITION OF THE LOW-ENERGY HELIUM NUCLEI IN THE PRIMARY COSMIC RADIATION. M. V. K. Appa Rao (Univ. of Rochester, N. Y.). Phys. Rev., 123: 295-300(July 1, 1961). (NYO-9553)

The isotopic composition of low-energy helium nuclei in the primary cosmic radiation is determined by using the "constant sagitta" scattering method on tracks of helium nuclei stopping in a nuclear-emulsion stack flown at a geomagnetic latitude of 55°N and at a mean atmospheric depth of 8.5 g/cm^2; tracks with zenith angles less than 30° are accepted. The ratio of $He^3/(He^3 + He^4)$ for the same energy per nucleon (between 200 and 400 Mev) is found to be 0.41 ± 0.09 at flight altitude. The correction for production of secondary He^3 in the residual atmosphere is calculated to be 4%. If one assumes that no He^3 nuclei are present at the source, the observed ratio corresponds to a traversal of 14 ± 3 g of interstellar matter by the low-energy helium nuclei. The value of $He^3/(He^3 + He^4)$ corresponding to the same magnetic rigidity (between 1.3 and 1.6 Bv) is found to be 0.36 ± 0.11 which corresponds to a traversal of 12.2 ± 3.5 g of interstellar matter. The observed ratio may indicate the presence of He^3 at the source of cosmic rays, or may be a reflection of local production within the solar system. (auth)

24199 EMISSION OF CARBON GROUP HEAVY NUCLEI FROM A 3+ SOLAR FLARE. Herman Yagoda (Air Force Cambridge Research Labs., Bedford, Mass.), Robert Filz, and Katsura Fukui. Phys. Rev. Letters, 6: 626-8(June 1, 1961).

Emulsion data from a Discoverer satellite are reviewed. This satellite was launched into a polar orbit at 2042 U.T. November 12, 1960, near the maximum of a 3+ solar flare,

and orbited for 50 hours. The spectrum of cosmic nuclear particles (mostly $Z = 6 \pm 2$) is calculated, and compared with similar measurements made during quiescent solar conditions. Properties of the solar flare are inferred from the data. (T.F.H.)

24200 ATMOSPHERIC EFFECTS ON THE INTENSITY OF COSMIC-RAY MESONS. II. THE TEMPERATURE EFFECT. Masami Wada. Sci. Papers Inst. Phys. Chem. Research (Tokyo), 55: No. 1, 7-23(Mar. 1, 1961). (In English)

The possibility of applying the mean mass temperature to the temperature correction for the sea level meson intensity is shown by theoretical and experimental procedures. The temperature effect is explained by introducing the partial temperature coefficient, which is a function of the atmospheric depth and independent of the variation of temperature distribution in the atmosphere. Calculations of the partial temperature coefficient are statistically examined. The mean mass temperature, $(\Delta T)_{12} = (1/x_2 - x_1)\int_{x_1}^{x_2} \Delta T(x)dx$, may be used in the temperature correction, because the calculated partial temperature coefficients are almost constant throughout the atmosphere. It is statistically shown that use of $(\Delta T)_{12}$ is equivalent to the theoretical method of representing the temperature effect, and is better than the ordinary method in which the height 100 mb level is used. The coefficient obtained is $-0.255 \pm 0.009\%/°C$, if $x_1 = 0$ and $x_2 = 1000$ mb. The atmospheric effect of meson intensity at sea level is given by $(\Delta I/I) = \beta_{total}\Delta P + \alpha_0\int_0^{1000} \Delta T(x)dx/1000$. (auth)

24201 GEOMAGNETIC EFFECT ON DIURNAL VARIATION OF COSMIC RAY INTENSITY. Kazuaki Murakami. Sci. Papers Inst. Phys. Chem. Research (Tokyo), 55: No. 1, 24-36(Mar. 1, 1961). (In English)

It is assumed that the geomagnetic dipole axis is inclined with respect to the axis of the earth's rotation, and the effect of this inclination on the diurnal variation of cosmic ray intensity is studied. This effect is plainly noticeable in the longitudinal dependence of the phase of the diurnal variation. Observed times of intensity maximum on a map and calculated times on the same map do not coincide. It is concluded that the geomagnetic field in the exosphere is to some extent distorted. This distortion and its effect on the latitudinal and longitudinal dependences of the diurnal variation of cosmic ray intensity are discussed. (auth)

24202 SOLAR MODULATION EFFECT ON THE LATITUDE DEPENDENCE IN COSMIC RAY INTENSITY. Shin Fukushima and Masahiro Kodama. Sci. Papers Inst. Phys. Chem. Research (Tokyo), 55: No. 1, 37-41(Mar. 1, 1961). (In English)

Latitude surveys of cosmic neutrons were carried out three times along the same route between Japan and the Antarctic from 1956 to 60. Annual changes of the cosmic-ray rigidity spectra deduced from these latitude curves followed changes of the solar activity, represented by sunspot relative numbers, by about half a year. Latitude surveys at airplane altitude also revealed a similar tendency. These facts suggested that about half a year elapsed between the appearance of a sunspot and the formation of conditions that affected the primary cosmic ray spectrum. (auth)

24203 THE ALTITUDE VARIATION OF AIR SHOWERS. Takashi Imai, Koichi Kamata, Shinkichi Kawasaki, Kazuaki Murakami, and Hajime Takeuchi. Sci. Papers Inst. Phys. Chem. Research (Tokyo), 55: No. 1, 42-8(Mar. 1, 1961). (In English)

The intensities of air showers S_1 and S_2, with particle densities of $45m^{-2}$ and $180m^{-2}$ respectively, are measured as functions of altitude from sea level to 6.4 km. At the lower half of the atmosphere, the observed intensities show an exponential decrease with the atmospheric depth, and the observed absorption coefficients are 120 ± 4 g · cm^{-2} of air for S_1 and 136 ± 10 g · cm^{-2} of air for S_2. The zenith angle dependence of air showers is also observed by the same apparatus in terms of the ratio of counting rates of the horizontal counters to those of the vertical counters. The observed ratio at 6.4 km is 2.43 ± 0.29 for S_1, and 2.3 ± 0.7 for S_2. This result is consistent with the altitude curve, and the comparison between the altitude curve and the zenith angle distribution is discussed. (auth)

24204 F. M. CHAMBER APPLIED TO ZENITH ANGLE DETECTION OF AIR SHOWER PARTICLES. Takashi Imai, Koichi Kamata, Shinkichi Kawasaki and Kazuaki Murakami. Sci. Papers Inst. Phys. Chem. Research (Tokyo), 55: No. 1, 49-52(Mar. 1, 1961). (In English)

A gaseous discharge chamber, the Fukui-Miyamoto (F. M.) chamber, is applied to the detection of zenith angles of air shower particles at airplane altitudes. This chamber has the advantage of being small in power consumption, light in weight, simple in construction, and stable in performance. It can detect in close succession many trajectories without causing spurious discharges, provided that the applied electric pulses are of sufficiently high voltage and short duration. For use in observation, two chambers are piled one on top of the other. Zenith angles of shower particles are determined from photographs taken of the discharges, with an error of 10 degrees. (auth)

Elementary Particles and Radiations

24205 (GAMD-957) PROPOSAL FOR AN EXPERIMENT TO MEASURE THE LIFE-TIME OF THE NEUTRON. F. J. Dyson (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Aug. 25, 1959. Contract AF18(600)-1812. 7p.

A proposal is made to measure the lifetime by a direct attenuation method. Discussion is given on previous experiments and the proposed bomb experiment is analyzed. The various difficulties of the experiment are summarized. (P.C.H.)

24206 (JINR-E-479) A POSSIBLE DECAY OF A NEUTRAL CASCADE MESON. E. V. Kuznetsov, E. I. Maltsev, A. Prokesh, G. M. Stashkov, I. V. Chuvilo, and I. A. Ivanovskaya (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 7p. 1960.

In cosmic ray investigations some events were observed which decayed according to the scheme $D^0 \rightarrow K^+ + \pi^- + Q$. An attempt was made to find particles with analogous decay modes which could be obtained from the beams of high-energy accelerators. Twenty thousand photographs taken during the exposure of the 2-liter xenon bubble chamber to a beam of π^- mesons with a momentum of 3 Bev/c were scanned. One event was found which could be the decay of a heavy meson by the scheme $D^0 \rightarrow K^+ + \pi^-$. An attempt was also made to calculate the mass of D^0 by the kinetics of production, assuming that D^0 is generated in the reaction $\pi^- + p \rightarrow n + D^0$. (M.C.G.)

24207 (NP-10371) POSITRON LIFETIMES AGAINST ANNIHILATION IN METALS AND ALKALI HALIDES (thesis). Technical Report No. 43. Betty Lou Dilmore Pollak (Washington Univ., St. Louis). Mar. 1961. Contract AF-18(603)108. 83p.

Experimental determinations of positron lifetimes in metals and alkali halides were carried out in order to check existing theories and to study the electronic aspects of the annihilation process. The lifetimes against annihilation were determined in Cu, Ag, Mg, LiF, NaF, NaCl, NaBr, NaI, KCl, KBr, KI, CsBr, and CsI. Previous work, both experimental and theoretical, is summarized. The positron source used was Na^{22} which emits positrons with an 0.542-Mev endpoint and almost simultaneously gives off a gamma ray of approximately 1.28-Mev energy. The time delay between the appearance of the 1.28-Mev gamma ray and the annihilation radiation (0.511 Mev) gave the positron lifetime. Curves of the time distribution of positron annihilations for the metals and alkali halides are given. The shortness of the observed positron lifetimes in the alkali halides supported the assumption that the positron is bound to the halogen ion. (M.C.G.)

24208 (UCRL-Trans-666(L)) ON THE THEORY OF SYSTEMS OF ELECTRICALLY CHARGED PARTICLES. A. E. Glauberman. Translated by Stephen G. Brush from Doklady Akad. Nauk S.S.S.R., 78: 883-5(1951). 4p.

An investigation is discussed which is concerned with calculating the successive approximations for the binary distribution function in systems of charged particles for which the coulomb function potential is replaced by a smooth potential, and 1/r is cut off at small r. This replacement can be considered physically as the introduction of some repulsive force, in a form which is convenient in applying the results of the calculation to solutions of electrolytes. (J.R.D.)

24209 (UCRL-Trans-668(L)) ON THE 'SUPERPOSITION' APPROXIMATION IN THE THEORY OF SYSTEMS OF INTERACTING PARTICLES. A. E. Glauberman and I. R. Yukhnovskii (Iukhnovskii). Translated by Stephen G. Brush (Univ. of California. Lawrence Radiation Lab.) from Doklady Akad. Nauk S.S.S.R., 93: 999-1002(1953). 6p.

The 'superposition' approximation for a sequence of distribution functions satisfying the Bogolyubov equations and describing a system of interacting particles in statistical equilibrium was studied to estimate the limit of its applicability. A system of charged particles with the system as a whole electrically neutral and under no external forces was considered. It was found that the approximation is applicable only for concentrations for which the correlation integral is small, or as long as it is possible to use only the zeroth approximation to the binary distribution function. (M.C.G.)

24210 (UCRL-Trans-669(L)) BINARY DISTRIBUTION FUNCTIONS FOR A SYSTEM OF INTERACTING CHARGED PARTICLES. I. R. Yukhnovskii (Iukhnovskii). Translated by Stephen G. Brush (Univ. of California. Lawrence Radiation Lab.) from Zhur. Eksptl'. i Teoret. Fiz., 27: 690-8(1954). 12p.

Bogolyubov's equation is solved for a neutral system of charged particles. The interaction between the particles is described by a potential which qualitatively takes account of short-range forces and removes the divergence at zero. General expressions are obtained for the first, second, ..., k'th approximations to the binary distribution function. (auth)

24211 PION PRODUCTION AND THE HIGHER RESONANCES IN PION-NUCLEON SCATTERING. P. Carruthers (Cornell Univ., Ithaca, N. Y.). Ann. Phys. (N. Y.), 14: 229-304(July 1961).

The reaction $\pi + N \rightarrow 2\pi + N$ has been studied in the vicinity of the higher resonances in the pion-nucleon cross section. The Low equation for the production amplitude is transformed into an integral equation by isolating the true one-meson intermediate states and discarding higher order contributions. The only part kept in the inhomogeneous term corresponds to the collision of a pion in the nucleon cloud with the incident pion in the resonant T = J = 1 state, which is simulated by an unstable vector Boson. Crossed terms are neglected and the 2π-N state is described by the static model. The terms kept in the sum over states describe the rescattering (off the nucleon) of one of the outgoing pions. The required off-the-energy-shell elastic scattering amplitude is approximated by the 3-3 resonance formula of Chew and Low. With these simplifications the Low equation for the production amplitude reduces to an easily soluble linear integral equation. The rescattering amplitude, which dominates the inhomogeneous term in the resonance region, is proportional to the 3-3 scattering amplitude of one of the outgoing pions. Although the result provides some support for the conventional isobar model, it is important to note that the largeness of the rescattering term arises from scattering far off the energy shell, rather than by "real" excitation as in the phenomenological isobar model. Quantitative calculations for the $D_{3,3}$ channel leading to a p-wave ($J = 3/2$) and an s-wave pion produce a maximum in the cross section near 600 Mev incident pion lab energy. For a π-π resonance energy squared S = 10, agreement with experiment is obtained with a width about one third that suggested by nucleon electromagnetic structure. In our approximation, the well known 600 Mev $D_{3,3}$ isospin $1/2$ resonance occurs at the same energy as the 800 Mev $D_{3,3}$ isospin $3/2$ resonance. It is assumed, but not proved, that the neglected terms are responsible for the splitting of the resonance energies. When this splitting is taken into account, the predicted charge state ratios near the second resonance agree well with existing data. The "third" resonance occurs for the state having two p-wave pions, according to the present theory, although no numerical calculations were made for this case. This point of view suggests that the $F_{5,5}$, $P_{3,3}$, and $P_{1,3}$ incident channels contribute to the third resonance. (auth)

24212 THE DIFFUSION OF RESONANCE EXCITATION THROUGH A GAS. R. G. McIntyre and R. G. Fowler (Univ. of Oklahoma, Norman). Astrophys. J., 133: 1055-66(May 1961).

The problem of diffusion of resonance radiation is studied by finding a Boltzmann equation for the distribution of excited states. A solution of the problem of a uniformly excited slab of gas is obtained. (auth)

24213 ON SOME PROBLEMS OF THE S-MATRIX FORMALISM FOR UNSTABLE PARTICLES. J. Werle (Inst. for Nuclear Research, Polish Academy of Sciences, [Warsaw] and Univ. of Warsaw). Bull. acad. polon. sci. Sér. sci., math., astron. et phys., 9: 207-10(1961). (In English)

Terms which describe decays and are—strictly speaking—not allowed for stable particles of definite mass are introduced into the S-matrix. Inconsistencies appear in the extended S-matrix formalism itself; however, the mass spread can be introduced and at least some of the inconsistencies are thereby removed. (L.N.N.)

24214 ON THE ANGULAR MOMENTUM WEIGHT FACTOR IN THE STATISTICAL THEORY OF MULTIPLE PARTICLE PRODUCTION. [PART] I. Z. Koba (Polish Academy of Sciences, Inst. of Nuclear Research [Warsaw]). Bull. acad. polon. sci. Sér. sci., math., astron. et phys., 9: 211-16(1961). (In English)

General properties, methods of evaluation, and a recurrence formula of the angular momentum weight factor $Z_n(l_1, l_2, \ldots, l_n)$ are described. The weight factor plays an essential role in the statistical treatment of the multiple particle production with angular momentum conservation and is defined by: $D^{(l_1)} \times D^{(l_2)} \times \ldots \times D^{(l_n-1)} = \sum_{\lambda} Z_n(l_1, l_2, \ldots, l_{n-1}, \lambda) \cdot D^{(\lambda)}$. (auth)

24215 CALCULATIONS OF WEAPONS RADIATION PENETRATION IN AIR. R. L. French and M. B. Wells (Convair, Fort Worth, Tex.). Health Phys., 5: 108-18 (June 1961).

The spatial, angular, and energy distributions of the initial radiation from a nuclear weapon were calculated on a theoretical basis. The radiation components considered were fission and prompt fission, fission product, and air-capture γ rays. The principal simplifying assumptions employed in the theoretical model were neglect of self-attenuation in the nuclear weapon; blast effect on air density; and ground effects. Comparisons were made with measured data which clearly demonstrate that the spatial, angular, and energy distributions of the initial radiations from a nuclear weapon are calculable. (auth)

24216 MEASUREMENT OF ELECTRON FLUX IN MEDIA BOMBARDED BY X-RAYS. D. R. Nelson, R. D. Birkhoff, R. H. Ritchie, and H. H. Hubbell, Jr. (Oak Ridge National Lab., Tenn.). Health Phys., 5: 203-11(June 1961).

The energy distribution of the electron flux generated by lightly filtered 250-kv constant potential x rays was determined for Cu, Al, and graphite in the form of pairs of parallel plates. The space between the plates was kept at high vacuum and the plate current was recorded as a function of plate voltage. Saturation currents of 0.0063, 0.0011, and 0.00024 esu cm^{-2} r^{-1} for the three chambers, respectively, were obtained at about 30 v plate potential. The energy distributions were calculated from the first and second derivatives of the current–voltage curves. The zero of energy was taken at the bottom of the conduction band. Observations were confined to those electrons able to escape from the material, i.e. those having an energy greater than $(E_F + \phi)$ were E_F is the Fermi energy and ϕ is the work function. The electron flux inside the plates was found to be largest at $E_F + \phi$, and to decline smoothly by an order of magnitude only 2 v higher. (auth)

24217 SCATTERING OF ELECTRONS BY THOMAS-FERMI POTENTIAL. S. C. Mukherjee (Indian Association for the Cultivation of Science, Jadavpur: Calcutta). Indian J. Phys., 35: 165-9(Apr. 1961). (In English)

The elastic scattering cross section of electrons by the Thomas-Fermi potential, as represented by the Gombas-Tietz analytical forms, is calculated by the Born approximation method. The results are in fair agreement with those calculated with the exact numerical form of the Thomas-Fermi potential. (auth)

24218 PION-HYPERON RESONANCES IN PION PRODUCTION IN HYPERON-NUCLEON COLLISIONS. S. N. Biswas and V. Gupta (Tata Inst. of Fundamental Research, Bombay). Nuclear Phys., 24: 620-9(1961). (In English)

A brief survey of the one-pion production phenomena in hyperon-nucleon collisions is presented. Equalities and inequalities among the cross sections for the various pion production reactions, based on the hypothesis of charge-independence, are given. The effect of the resonances of the pion-nucleon and pion-hyperon systems in the final state is considered. The modification of these results due to the restricted symmetry hypothesis is also pointed out. Finally, the possibility of ascertaining the relative Σ-Λ parity from the angular distribution is indicated. (auth)

24219 STRANGE PARTICLES. André Lagarrigue (Ecole Polytechnique, Paris). Nucleus (Paris), No. 1, 21-31(Jan.-Feb. 1961). (In French)

As an introduction to the discussion of the Gell-Mann theoretical description of strange particles, the formation of strange particles and their discovery and experimental properties are described. (J.S.R.)

24220 PARTIAL WAVE DISPERSION RELATIONS IN $\bar{K}$-NUCLEON ABSORPTION. [PART] I. R. G. Moorhouse (Glasgow Univ.). Nuovo cimento (10), 20: 123-39(Apr. 1, 1961). (In English)

Using the double dispersion relations, the singularities of partial wave amplitudes for transitions between the coupled channels $\bar{K} + N$, $\pi + \Sigma$, and $\pi + \Lambda$ are found. A formalism for solving the dispersion relations, using the unitarity condition, is given. (auth)

24221 PHOTONS FROM THE RADIATIVE PION DECAY. D. M. Binnie, S. L. de S. Barros, and B. D. Hyams (Univ. of Manchester, Eng.). Nuovo cimento (10), 20: 140-51(Apr. 1, 1961). (In English)

The detection of photons from the radiative pion decay mode $\pi \rightarrow \mu + \nu + \gamma$ is reported. While there are uncertainties in the calculations, the results are consistent with the V–A theory of weak interactions and with nuclear emulsion investigations of anomalous π-μ decays. (auth)

24222 PION-HYPERON SCATTERING. M. M. Islam (Imperial Coll. of Sci. and Tech., London). Nuovo cimento (10), 20: 161-71(Apr. 1, 1961). (In English)

A dispersion theoretic technique is used to derive the static equations for pion-hyperon scattering, and it is shown that the inclusion of the $\bar{K}N$ channel does not change the conclusions on the $J = \frac{3}{2}$, $I = 1$, p-wave π-Y resonance. (auth)

24223 POLARIZATION OF $\bar{p}$ IN $\bar{p}C$ SCATTERING. P. K. Srivastava (Univ. of Chicago). Nuovo cimento (10), 20: 172-4(Apr. 1, 1961). (In English)

The polarization of the emergent $\bar{p}$ is estimated for $\bar{p}C$ and $\bar{p}p$ scattering. A model is used in which the nucleon-nucleon interaction contains a $T = 0$, $J = 1$ 3π resonance. The nuclear optical model for the target particle is used to find the central and spin-orbit potentials. A square-well nuclear shape is assumed. The $\bar{p}$ polarization is found at 160 Mev/c for the $\bar{p}C$ scattering, and at 1.60 Bev/c for the $\bar{p}p$ interaction. (T.F.H.)

24224 OBSERVATION OF A HYPERFRAGMENT DECAY BY π^0 EMISSION. I. R. Kenyon (Clarendon Lab., Oxford). Nuovo cimento (10), 20: 175-7(Apr. 1, 1961). (In English)

An event is described in nuclear emulsion in which a Σ^- is captured at rest, emitting two prongs. One of these prongs is interpreted as a hyperfragment. Two electrons are observed to be emitted from the hyperfragment decay. Kinematical fits to the observed data are calculated, assuming a decay of the type ${}_Z X^A_\Lambda \rightarrow {}_Z X^{A-k} + \pi^0 + k$ neutrons, with Z less than 5 and internal conversion of the γ rays from π^0 decay. (T.F.H.)

24225 APPLICATION OF THE CHEW AND LOW EXTRAPOLATION PROCEDURE TO $K^- + d \rightarrow Y + N + \pi$ ABSORPTION REACTIONS. J. S. Dowker (Univ. of Birmingham, Eng.). Nuovo cimento (10), 20: 182-4(Apr. 1, 1961). (In English)

The reaction $K^- + d \rightarrow Y + N + \pi$ at rest is studied in an impulse approximation. It is suggested that data from this reaction be extrapolated to the pole at momentum transfer $p^2 = \alpha^2/M$, where α^2/M = deuteron binding energy and M = nucleon mass. This extrapolation procedure should yield

information regarding the Dalitz-Tuan scattering length parameters for the $K + N \rightarrow Y + \pi$ reaction below threshold. (T.F.H.)

24226 THEORETICAL DISCUSSION OF POSSIBLE EXPERIMENTS WITH ELECTRON-POSITRON COLLIDING BEAMS. N. Cabibbo and R. Gatto (Università, Rome and Cagliari, Italy and CNEN, Frascati, Italy). Nuovo cimento (10), 20: 185-93(Apr. 1, 1961). (In English)

Theoretical aspects of e^+-e^- colliding beams are considered. The reactions $e^+ + e^- \rightarrow f + \bar{f}$, $e^+ + e^- \rightarrow b + \bar{b}$, and $e^+ + e^- \rightarrow B + \bar{B}$ are studied, where f indicates a fermion, b a spin-zero boson, and B a spin-one boson. These reactions may be used to find the form factors of strongly interacting f, b, and B particles. The uses of e^+-e^- reactions to detect the $T = J = 1$ π-π resonance, the ρ^0 meson, and semiweakly interacting vector bosons are outlined. (T.F.H.)

24227 A NOTE ON THE DEUTERON PHOTODISINTEGRATION. V. De Alfaro and C. Rossetti (Università, Turin and Istituto Nazionale di Fisica Nulceare, Turin). Nuovo cimento (10), 20: 194-7(Apr. 1, 1961). (In English)

The deuteron photodisintegration reaction is studied theoretically. The coupling constant for the reaction is found by consideration of the scattering matrix. An extrapolation procedure is then followed for experimental data in order to obtain an empirical coupling constant. (T.F.H.)

24228 STRUCTURE OF A QUANTIZED VORTEX IN BOSON SYSTEMS. E. P. Gross (CERN, Geneva). Nuovo cimento (10), 20: 454-77(May 1, 1961). (In English)

A theory of the elementary line vortex excitations is developed for a system of weakly repelling bosons. The vortex state is characterized by the presence of a finite fraction of the particles in a single particle state of integral angular momentum. The radial dependence of this state follows from a self-consistent field equation. The radial function and the associated particle density are essentially constant everywhere except inside a core, where they drop to zero. The core size is the de Broglie wavelength associated with the mean interaction energy per particle. The expectation value of the velocity has the radial dependence of a classical vortex. In this Hartree approximation the vorticity is zero everywhere except on the vortex line. When the description of the state is refined to include the zero point oscillations of the phonon field, the vorticity is spread out over the core. The phonons moving perpendicular to the vortex line are coherent excitations of equal and opposite angular mememtum relative to the substratum of moving particles that constitute the vortex. The vortex motion resolves the degeneracy of the Bogoljubov phonons with respect to the azimuthal quantum number. (auth)

24229 RADIATIVE CORRECTIONS TO PION PRODUCTION IN e^+-e^- COLLISIONS. G. Putzolu (CNEN, Frascati, Italy). Nuovo cimento (10), 20: 542-5(May 1, 1961). (In English)

Radiative corrections to the processes $e^+ + e^- \rightarrow n$ pions are evaluated in relation to colliding beam experiments. A theorem is proved that shows the possibility of separating experimentally the contribution of the γ-n pion vertex from the contribution of the 2γ-n pion vertex. (auth)

24230 K-MESON-NUCLEON SCATTERING. M. M. Islam (Imperial Coll. of Science and Tech., London). Nuovo cimento (10), 20: 546-52(May 1, 1961). (In English)

Assuming that the isotropy of KN scattering in $I = 1$ is due to the cancellation of p-wave contributions coming from the hyperon cuts and the two-pion cut, the KN scattering in the $I = 1$ s-state and in the $I = 0$, s-, p -, and $p_{\frac{3}{2}}$-states is investigated. Qualitative agreement with experiment is obtained. Using crossing symmetry, the two-pion contribution in $\bar{K}N$ scattering is also considered. (auth)

24231 MODIFIED STATIC EQUATIONS FOR THE Kπ-INTERACTION. EFFECT OF PION-PION RESONANCE. B. W. Lee and K. S. Cho (Univ. of Pennsylvania, Philadelphia). Nuovo cimento (10), 20: 553-69(May 1, 1961). (In English)

An approximate version of the double dispersion representation for the Kπ interaction is reduced to an integral equation in one variable. The resulting equation has the structure of a static theory equation but incorporates the effect of the $\pi + \pi \rightarrow K + \bar{K}$ channel on Kπ scattering and satisfies the condition at the symmetry point prescribed by the relativistic theory. A slight distortion of the crossing matrix makes possible an exact solution to the equation. The construction of approximate unitary amplitudes for the Kπ interaction, which satisfy the crossing relations, is discussed. (auth)

24232 ELASTIC SCATTERING OF 1.25 MEV γ RAYS IN LEAD. G. Manuzio and S. Vitale (Università, Geneva and Istituto Nazionale di Fisica Nucleare, Geneva). Nuovo cimento (10), 20: 638-47(May 16, 1961). (In Italian)

The degree of transverse polarization of the radiation from a Co^{60} source, elastically scattered by a lead target, was measured at various angles. Experimental results are shown. A comparison was made between these and the theoretical predictions for the contribution of the Thomson and Rayleigh effects. Amplitudes calculated for K electrons by Brown and Mayers were used. For an accurate test of the theoretical situation by means of the experimental results, refined calculations of L-shell contribution to Rayleigh scattering are needed. (auth)

24233 K^- ABSORPTION IN ^{4}He. I. THE HYPERON-PION RESONANCE. M. M. Block (Duke Univ., Durham, N. C.), E. B. Brucker, R. Gessaroli, T. Kikuchi, A. Kovacs, C. M. Meltzer, R. Kraemer, M. Nussbaum, A. Pevsner, P. Schlein, R. Strand, H. O. Cohn, E. M. Harth, J. Leitner, L. Lendinara, L. Monari, and G. Puppi. Nuovo cimento (10), 20: 724-32(May 16, 1961). (In English)

Results are given on a hyperon-pion resonance. This resonance was investigated in the absorption of K^- mesons in He^4. This experiment was performed using the Duke helium bubble chamber. Tentative assignments of spin, parity, and level width of the Y^* state are given. (auth)

24234 NOTE ON THE $\Delta I = \frac{1}{2}$ SELECTION RULE IN THE COMPOSITE MODEL OF ELEMENTARY PARTICLES. S. Okubo and R. E. Marshak (CERN, Geneva). Nuovo cimento (10), 20: 791-6(May 16, 1961). (In English)

The Salam-Ward hypothesis concerning the $\Delta I = \frac{1}{2}$ selection rule in weak interactions is examined from the viewpoint of the composite model of elementary particles. In this theory, the nonleptonic weak decays have a different origin than the leptonic decays and are attributed to a small perturbation on the strong interactions. (auth)

24235 ON WEAK PION INTERACTION IN NONLEPTONIC HYPERON DECAYS. W. Królikowski (Inst. for Advanced Study, Princeton, N. J.). Nuovo cimento (10), 20: 797-802(May 16, 1961). (In English)

It is shown that isotopic and parity properties of nonleptonic hyperon decays can be explained qualitatively by a weak pion-baryon interaction, in which: (1) pions are coupled to matrices describing fundamental (or doublet) and strange isospins of baryons; (2) all isospin matrices are multiplied by a strangeness-changing neutral matrix;

and (3) the fundamental isospin matrices are multiplied by γ_5, whereas the strange ones are not. It follows from (1) and (2) that this interaction satisfies automatically the rule $|\Delta T| = \frac{1}{2}$ and also the Pais' rule $|\Delta I| = 0$ or 1. The hypothetical connection (3) between τ matrices and γ_5 may be significant for understanding the mutual relations of strong and weak pion interactions. It gives the parity clash discussed by Pais. (auth)

24236 PHOTOPRODUCTION OF NEUTRAL VECTOR MESONS. M. Bassetti (CNEN, Frascati, Italy). Nuovo cimento (10), 20: 803-5(May 16, 1961). (In English)

The cross section for the process $\gamma + p \rightarrow p + x$ is calculated, where x is a neutral vector meson. (L.T.W.)

24237 PHOTOELECTRIC EFFECT AND PAIR ANNIHILATION WITH LARGE MOMENTUM TRANSFER. David S. Moroi (Ames Lab., Ames, Iowa). Phys. Rev., 123: 167-74(July 1, 1961). (IS-117)

The photoelectric effect and pair annihilation with large momentum transfer are studied in hydrogen, taking into account the recoil and anomalous magnetic moment of the proton, in an effort to see whether these processes can be used to study quantum electrodynamics at small distances. A negative result is obtained. It turns out that for an incident energy of 100 Mev the important term, containing the electron propagator that is sensitive to small distance modifications, is about 0.5% as large as the term that is insensitive to the modifications. The proton structure is described by two covariant form factors determined by the electron-proton scattering. The differential cross sections are calculated in the Born approximation in the laboratory system, neglecting the binding energy of the hydrogen atom. The results are analyzed in the extreme relativistic energy range and in the special case in which the outgoing electron (photon) emerges perpendicular to the incident beam. The total cross sections are calculated in the high-energy approximation. The differential cross sections are very small ($\sim 10^{-42}$ to 10^{-40} cm^2/sr). The cross section calculations, if applied to an atom with higher atomic number Z, give differential cross sections for the above processes larger by a factor Z^2, if screening is neglected. For an Au target the differential cross sections are then of the order of 10^{-33} to 10^{-31} cm^2/sr. However, this extension of the calculations introduces a considerable error in the differential cross sections, because the influences of the Coulomb field and anomalous magnetic moment of a nucleus on the electron wave functions are neglected. These calculations serve only as an estimate of the order of magnitude of the differential cross sections. (auth)

24238 MAGNETIC MOMENT OF THE PROTON IN UNITS OF THE NUCLEAR MAGNETON. H. S. Boyne and P. A. Franken (Univ. of Michigan, Ann Arbor). Phys. Rev., 123: 242-54(July 1, 1961).

A method for measuring the magnetic moment μ_p of the proton in units of the nuclear magnetion is described. The cyclotron frequency of free low-energy H_2^+ ions is measured with a low-power absorption technique as a function of magnetic field. The extrapolation technique is utilized to correct for shifts produced by electrostatic fields. The measurements yield $\mu_p = 2.792\ 83 \pm 0.000\ 06$. (auth)

24239 NUCLEON-ANTINUCLEON MECHANISM FOR PION-PION SCATTERING RESONANCES. Johan G. Belinfante (Princeton Univ., N. J.). Phys. Rev., 123: 306-7(July 1, 1961).

The Chew-Mandelstam N/D equations for pion-pion scattering were modified to include contributions from the nucleon-antinucleon intermediate state, which was estimated in perturbation theory as well as by limitations imposed by unitarity alone. It was found that the Frazer T = 1 P-wave resonance could not be obtained by such a simple mechanism, starting from S-wave dominant solutions. (auth)

24240 LONG-RANGE INTERACTION IN $\bar{K}$-NUCLEON AND K-NUCLEON ELASTIC AMPLITUDES. Fabio Ferrari, Graham Frye, and Modesto Pusterla (Univ. of California, Berkeley). Phys. Rev., 123: 308-14(July 1, 1961). (UCRL-9421)

For the K-nucleon interaction, a method is derived for calculating the long-range force arising from the exchange of a pion pair and from a possible three-pion resonant state. It is shown that the long-range force can be related with the electromagnetic structure parameters of the nucleon and K meson. Finally, relations between K-nucleon and $\bar{K}$-nucleon elastic amplitudes are discussed. (auth)

24241 ENERGY DEPENDENCE OF THE LOW-ENERGY K^--PROTON AND K^+-PROTON CROSS SECTIONS. Fabio Ferrari, Graham Frye, and Modesto Pusterla (Univ. of California, Berkeley). Phys. Rev., 123: 315-20(July 1, 1961). (UCRL-9434)

The K^--proton and K^+- proton S-wave scattering is analyzed, using a relativistic effective-range formula derived from the analytic properties of partial-wave scattering amplitudes. The influence of the pion-pion interaction on the elastic scattering and reaction cross sections is discussed. (auth)

24242 K^-–p AND K^-–n CROSS SECTIONS IN THE MOMENTUM RANGE 1-4 BEV/c. V. Cook, Bruce Cork, T. F. Hoang, D. Keefe, L. T. Kerth, W. A. Wenzel, and T. F. Zipf (Univ. of California, Berkeley). Phys. Rev., 123: 320-32(July 1, 1961). (UCRL-9386)

The energy dependence of the K^--nucleon total cross sections is measured over the K^- momentum range 0.98 to 3.98 Bev/c. K^-–n cross sections are obtained by deuterium-hydrogen subtraction, with a correction for screening effects. There is evidence for structure in the T = 0 K^--nucleon state in the momentum range 0.98 to 2.0 Bev/c. This structure is absent in the T = 1 state. In addition, a measurement is made at 1.95 Bev/c of the angular distribution of the K^-–p elastic scattering at small angles. The forward-scattering amplitude obtained from the data gives a ratio of real part to imaginary part 0.5 ± 0.2 at 0^0. The corresponding ratio for π^- mesons at this momentum was found to be $0.4^{+0.2}_{-0.4}$. Measurements of the K^-–p "elastic" charge exchange give a cross section that falls from about 10 mb at 1 Bev/c to at most a few mb at 4 Bev/c. (auth)

24243 EXTENSION OF THE ISOBARIC NUCLEON MODEL FOR PION PRODUCTION IN PION-NUCLEON, NUCLEON-NUCLEON, AND ANTINUCLEON-NUCLEON INTERACTIONS. R. M. Sternheimer and S. J. Lindenbaum (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 123: 333-76(July 1, 1961). (BNL-5380)

The isobaric nucleon model of pion production in nucleon-nucleon and pion-nucleon collisions is extended to include the effect of the higher resonances in the isotopic spin $T = \frac{1}{2}$ state of the pion-nucleon system, in addition to the effect of the low-energy $T = \frac{3}{2}$ resonance. The higher $T = \frac{1}{2}$ resonances are centered at incident pion energies of 600 and 880 Mev, and thus correspond to isobar masses $m_I = 1.51$ and 1.68 Bev, respectively, as compared to $m_I = 1.23$ Bev for the $T = \frac{3}{2}$ resonance. For the inelastic pion-nucleon interactions, calculations of the various pion and recoil nucleon energy spectra are carried out for incident pion energies T_π = 1.0, 1.4, and 2.0 Bev. Both single and double pion production by the incident pion are considered, corresponding to two-

pion and three-pion final states, respectively. General equations for the center-of-mass energy spectra of the final-state pions and nucleons are obtained for all single and double pion production reactions from both $\pi^- - p$ and $\pi^+ - p$ collisions. The results of the extended isobar model at T_π = 1.0 Bev are in reasonable agreement with data on $\pi^- - p$ interactions in the region of 1.0 Bev incident energy. The Q value distributions for pion-nucleon and pion-pion pairs are calculated for single pion production at T_π = 1.0 Bev. The model can also be used to treat up to four-pion final states in $\pi - N$ interactions, and up to eight-pion final states in $N - N$ interactions. For pion production in nucleon-nucleon collisions, the branching ratios are obtained for all pion production reactions that involve isobaric states corresponding to the $T = \frac{3}{2}$ and $T = \frac{1}{2}$ resonances. General equations for the energy spectra of the final-state pions and nucleons are derived for all single- and double-pion production reactions from both $p - p$ and $n - p$ collisions. Calculations of the various pion and nucleon energy spectra have been carried out for incident nucleon energies of 2.3 and 3.0 Bev. For the processes of pion production in antinucleon-nucleon interactions which do not result in annihilation, it has been assumed that an anti-isobar $\overline{N}_\alpha{}^*$ can be produced, which is the antiparticle of the isobar $N_\alpha{}^*$. Specific results are obtained for both single and double pion production in $\overline{p} - p$, $\overline{p} - n$, and $\overline{n} - p$ collisions. (auth)

24244 STRUCTURE OF RADIATIVE DECAY AMPLITUDES. H. Chew (Univ. of Chicago). Phys. Rev., 123: 377-81(July 1, 1961).

It is shown that the matrix element for decay processes involving the emission of a single photon may be obtained from the matrix element for the corresponding nonradiative decay and the magnetic moments of the particles involved, up to terms that vanish as the photon frequency $K \to 0$. Detailed discussions are given for decays involving three and four spinless particles, as well as for four spin-$\frac{1}{2}$ particles. The results are similar to those for bremsstrahlung in scattering processes, but some differing features arise when the nonradiative decay is forbidden by selection rules. (auth)

24245 COMPOSITE MODEL AND PARTIALLY CONSERVED CURRENTS IN WEAK INTERACTIONS. S. Okubo and R. E. Marshak (CERN, Geneva). Phys. Rev., 123: 382-3(July 1, 1961).

It is shown that the idea of partially conserved currents has a basis in the composite model. Within this framework, the Goldberger-Treiman relation for the pion lifetime is discussed without recourse to dispersion theory. (auth)

24246 RELATIVISTIC ELECTRON-PAIR SYSTEMS AND THE STRUCTURE OF NEUTRAL MESONS. Ernest J. Sternglass (Westinghouse Research Labs., Pittsburgh). Phys. Rev., 123: 391-8(July 1, 1961).

In an effort to obtain a semiclassical model for the neutral π meson, a Bohr-Sommerfeld type of system with the proton replaced by a positron is investigated in the limit of high velocities. It is found that as a result of the relativistic increase in the electromagnetic field between the two moving charges, a natural minimum approach distance occurs equal to one-half of the classical "shell-electron" radius. At this separation, a new set of quantized states becomes possible, which is found to be energetically unstable. The lowest state possesses an energy approximately equal to the π^0 meson energy. The relativistic states are characterized further by the greatly increased importance of perihelion precession, which accounts for one-half of the total angular momentum in the extreme relativistic case. When the effect of procession on the intrinsic magnetic moment is taken into account, the total energy of the system is found to be $263 m_0 c^2$, in close agreement with the observed π^0 mass. The lifetime of the system against annihilation into two gamma rays is calculated on the basis of the close analogy to singlet positronium. Its value is found to be 2.06×10^{-16} sec, in agreement with the observed π^0 meson lifetime. The implications for the structure of other nuclear particles and their interactions are discussed. (auth)

24247 PION-PION INTERACTION IN PION-PRODUCTION BY π^+-p COLLISIONS. D. Stonehill, C. Baltay, H. Courant, W. Fickinger, E. C. Fowler, H. Kraybill, J. Sandweiss, J. Sanford, and H. Taft (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 6: 624-5(June 1, 1961).

The reactions $\pi^+ + p \to \pi^+ + \pi^0 + p$ and $\pi^+ + p \to \pi^+ + \pi^+ + n$ are studied at 910, 1090, and 1260 Mev, in an attempt to detect a π-π resonance. For the outgoing $\pi^+\pi^0$ pair, peaks in the Q-values lead to a di-pion resonance with a mass of 5.0 to 5.5 pion masses and I = 1 or 2. No resonance is observed in the outgoing $\pi^+\pi^+$ (I = 2) pair, leading to the conclusion that the $\pi\pi$ resonance is a I = 1 state. (T.F.H.)

24248 INELASTIC ELECTRON-DEUTERON SCATTERING AND THE ELECTROMAGNETIC STRUCTURE OF THE NEUTRON. Loyal Durand, III (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 6: 631-4(June 1, 1961).

The neutron charge and magnetic moment form factors F_{1n} and F_{2n} are calculated from data on the reaction $e + d \to e + p + n$. Proton form factors that are used in the calculations are those found in e-p scattering. The cross sections for $e + d \to e + p + n$ are calculated by means of a completely covariant theory, using dispersion relations. These cross sections are used to find F_{1n} and F_{2n}, for momentum transfers of $q^2 = 5$ to $21\,f^{-2}$. (T.F.H.)

24249 PROTON-PROTON INTERACTION. H. Feshbach and E. Lomon (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters, 6: 635-8(June 1, 1961).

A model for p-p interactions below 350 Mev is studied, which contains a boundary condition to represent the short-range potential, and a fourth order static perturbative tail for the long-range interaction. The scattering phase shifts and wave functions are found for various energies and quantum states. Pair suppression, ladder, and one- and two-pion-exchange effects are included in the potential. (T.F.H.)

24250 CONSEQUENCES OF A SCALAR $\Sigma\Lambda\pi$ COUPLING. Jeremy Bernstein and Reinhard Oehme (Universität, Vienna). Phys. Rev. Letters, 6: 639-41(June 1, 1961).

Under the assumption of odd $\Sigma\Lambda$ parity, the properties of the scalar $\Sigma\Lambda\pi$ coupling are examined. The $\Sigma\Lambda\pi$ coupling constant is approximated. Using this approximation, the properties (rates, etc.) of the reactions $\Sigma^+ \to \Lambda^0 + e^+ + \nu$; $\Sigma^- \to \Lambda^0 + e^- + \overline{\nu}$; and $\Sigma^0 \to \Lambda^0 + \gamma + \gamma$ are inferred. (T.F.H.)

24251 POSSIBLE MECHANISM FOR THE PION-NUCLEON SECOND RESONANCE. Ronald F. Peierls (Birmingham Univ., Eng.). Phys. Rev. Letters, 6: 641-3 (June 1, 1961).

The second, third, and higher resonances of the π-N system are studied. A model is proposed in which the 33 π N isobar is considered as an unstable particle with complex mass, designated as N^*. The second resonance (N^{**}) is explained as an s-wave πN^* interaction, and the third resonance (N^{***}) as a sum of p-wave πN^* interactions.

The broad resonance above 1 Bev is explained as a sum of πN^{**} and πN^{***} interactions. (T.F.H.)

24252 SCATTERING MATRIX APPROACH TO THE λ-π RESONANCE. K. C. Wali, T. Fulton, and G. Feldman (Johns Hopkins Univ., Baltimore). Phys. Rev. Letters, 6: 644-5(June 1, 1961).

The $\pi\Lambda$ resonance is studied in the energy range from $m_\pi + m_\Lambda$ to $m_N + m_K$, using an effective-range theory. The effects of the three channels $\pi\Lambda$, $\pi\Sigma$, and $\bar{K}N$ are considered, taking I = 1 and assuming odd relative $\Lambda\Sigma$ and ΛK parities. The scattering matrix is used to study the resonance properties of the system, and it is found that a resonance can exist, with (I,J) = $(1,\frac{1}{2}-)$, that is consistent with experimental data. $\Lambda\Sigma$ even parity does not yield this $(1,\frac{1}{2}-)$ resonance. (T.F.H.)

24253 PION-NUCLEON INTERACTION AND THE MULTIPLE-PRODUCTION EXPERIMENT. Hiroshi Ezawa (Tokyo Univ.), Osamu Kamei, Kenju Mori, Hiroo Shimoida, and Tohru Yoneyama. Progr. Theoret. Phys. (Kyoto), 25: 667-83(Apr. 1961).

A method is proposed for investigation of the pion-nucleon interaction by using the multiple-production experiments at extremely high energy. The method consists of calculating theoretically the characteristics of the collision event with small multiplicity of meson production and comparing the results with extrapolated experimental data for multiple production. The perturbation calculation is performed for the single-pion production process. Although the fit of the results with the extrapolations is not entirely satisfactory, it may be concluded that pion-nucleon coupling of the pseudo-scalar type is preferable to that of the pseudo-vector type. (auth)

24254 STRANGE NEUTRINO AND A COMPOSITE MODEL FOR ELEMENTARY PARTICLE. [PART] I. Tadashi Ouchi and Kei Senba (Univ. of Hiroshima). Progr. Theoret. Phys. (Kyoto), 25: 684-700(Apr. 1961).

A composite model of the elementary particle is proposed by taking the stable particles, namely the proton, electron, neutrino and strange neutrino (ν'), as the basic particles. The strange neutrino is introduced by mass reversal theory as the β decay product of the Λ-particle. It differs from the usual neutrino by mass parity and carries a unit of strangeness. Two neutrinos are both left-handed two-component Dirac spinors. This model simplifies the mechanism of interactions because the basic particles are limited to the stable ones. It is noted that the charge independent strong interactions uniquely require a "vacuum-cloud," which is always attached to the core of the elementary particle. The interactions observed are empirically classified by the three independent reactions inside the core. The origin of the strong interactions is the reaction $P \rightharpoonup \pi^0 P$, where π^0 is the symbol for the state $P\bar{P}$; the reactions responsible for the leptonic decays of baryons are only $\mu\nu \rightharpoonup e\nu$ and $\mu\nu' \rightharpoonup e\nu'$; and the non-leptonic decays of baryons take place through the strangeness non-conserving reaction, $\nu' \rightharpoonup \pi^0\nu$. The selection rules for the leptonic events are established. The event $\Sigma^+ \rightharpoonup N + e^+ + \nu'$ is possible. The existence of a pion $\pi^{0\prime}$ with I = 0 is suggested. (auth)

24255 A REMARK ON THE STRANGENESS AND ISOTOPIC SPIN FOR LEPTONS. Takao Okabayashi, Seitaro Nakamura, and Yoshio Nisiyama (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 25: 701-12(Apr. 1961).

The strangeness and isotopic spin assignments for leptons are studied, to determine if they fit the leptonic weak interactions as well as the weak interactions between baryons and mesons. It is shown that there should exist two kinds of neutral massless leptons (ordinary and strange neutrino) in order that the selection rule $|\Delta S| = 1$ be valid. Then all the observed weak interactions satisfy this rule, but the strangeness assignment allows some strangeness conserving leptonic processes such as $K^0 \rightharpoonup \mu^+ + e^-$ and $K^+ \rightharpoonup \mu^+ + e^- + \pi^+$. Further, there are some unallowed processes in which $|\Delta S| = 1$, for instance, $\mu^+ \rightharpoonup 2e^+ + e^-$ and $\mu^- + p \rightharpoonup p + e^-$. It is possible to draw any definite conclusion about the isotopic spin selection rule. It is shown that, except for $\mu \rightharpoonup e + \nu + \bar{\nu}$, $\mu^- + p \rightharpoonup n + \nu$, and probably $\pi \rightharpoonup \mu + \nu$, the selection rule $|\Delta I| = \frac{1}{2}$ is valid to a good approximation, for the interactions in which $|\Delta S| = 1$. The significance of the existence of the exceptional cases is discussed. (auth)

24256 THE CERENKOV SELF-EXCITATION OF THE ELECTRON. Thomas Erber (Illinois Inst. of Tech., Chicago). Progr. Theoret. Phys. (Kyoto), 25: 714-16 (Apr. 1961).

A charged particle traversing a medium at super-light velocities may, besides emitting Cherenkov radiation, undergo transitions into its excited states. It is shown that the μ meson may be regarded as an excited state of the electron. The vacuum polarization in the vicinity of an atomic nucleus is shown to be capable of changing the refractive index from that of free space. A minimum Cherenkov energy is found for the self-excitation of the electron into a μ meson, in the immediate vicinity of a nucleus. (T.F.H.)

24257 ON THE "NAGOYA MODEL" OF THE ELEMENTARY PARTICLES. Nikola St. Kalitzin (Inst. of Physics, Bulgarian Academy of Sciences, Sofia). Progr. Theoret. Phys. (Kyoto), 25: 719-20(Apr. 1961).

Elementary particle models are discussed in which the baryons p,n,Λ are assumed to be composed of a particle B^+ bound very tightly to the leptons ν, e^-, μ^- respectively. The Nagoya formulation of this model is compared with an earlier formulation by St. Kalitzin. (T.F.H.)

24258 SCATTERING OF ALPHA PARTICLES. R. M. Eisberg (Univ. of Minnesota, Minneapolis) and C. E. Porter. Revs. Modern Phys., 33: 190-230(Apr. 1961). (BNL-5301)

A résumé of early and recent α-particle scattering experiments is given, including an account of the first cyclotron experiments. Various models used to explain the α-nucleus interaction are outlined, including the Akhezier-Pomeranchuk-Blair models, the Ford-Wheeler model, the classical strong absorption model, and various optical models. The validity of each of these models using heavy and light target nuclei is investigated. Theory and experimental data on elastic scattering and total reaction cross sections are presented. (T.F.H.)

24259 MESONS AND HYPERONS. G. A. Snow and M. M. Shapiro (Univ. of Maryland, College Park and U. S. Naval Research Lab., Washington, D. C.). Revs. Modern Phys., 33: 231-8(Apr. 1961).

A survey is made of mesons (π,K), hyperons (Λ, Σ, Ξ), and their antiparticles. The mass, mean life and decay mode, spin, and parity of each of these particles are detailed. The concept of strangeness is reviewed. (T.F.H.)

24260 ELECTRON POLARIZATION OPERATORS. D. M. Fradkin (Ames Lab., Ames, Iowa) and R. H. Good, Jr. Revs. Modern Phys., 33: 343-52(Apr. 1961). (IS-186)

Two types of electron polarization operators are surveyed. A three-vector operator is described that is appropriate for calculations involving plane-wave states. A four-vector operator is described that can be used for taking account of external electromagnetic fields. (T.F.H.)

24261 MULTIPLE GENERATION OF PARTICLES IN (π, p) INTERACTIONS AT MULTI-BEV ENERGIES. B. V. Eliseev and V. V. Pashkevich. Vestnik Moskov. Univ. Ser. III. Fiz., Astron., No. 5: 3-5(Sept.-Oct. 1960). (In Russian)

The mean numbers of π mesons produced at 1.7 and 3.0 Bev are, respectively, 1.86 and 2.50 (with 1.17 and 1.59 charged particles). In 3-Bev reactions the mean number of K^+ mesons produced is 0.059. (R.V.J.)

24262 GAMMA RAY PENETRATION THROUGH PLANE LAYER. Sh. S. Nikolaishvili. p.183-98 of "Nekotorye Matematicheskie Zadachi Neitronnoi Fiziki." Publishing House of the Moscow University, 1960.

Gamma penetration through a homogeneous plane is considered in the energy region where secondary processes related to pair production and the photoeffects can be neglected. The consecutive approximation convergence process was investigated, and the intensity multiple scattering was evaluated. The case of monochromatic normal radiation incidence was studied, and a formula was derived for the intensity of double scattering. Tables and graphs of double scattering, calculated for lead at $1/\lambda_0 = 20\ mc^2$, are included. Calculations are made up to $1.818\ mc^2$ for three depths of penetrations: 4.65, 9.30, and 23.25 cm. (R.V.J.)

24263 CONVERGENCE OF KINETIC EQUATION APPROXIMATION SOLUTIONS (METHOD OF GAUSS-TYPE QUADRATURES). V. A. Chuyanov. p.199-220 of "Nekotorye Matematicheskie Zadachi Neitronnoi Fiziki." Publishing House of the Moscow University, 1960.

The convergence of kinetic equation approximation solutions is evaluated. The evaluation method is analyzed on the basis of the simplest case of isotropic scattering in plane geometry. The problem of an isotropically scattering layer bound by two parallel planes exposed to a particle flux is analyzed. (R.V.J.)

Neutron Physics

24264 (AD-253576) DIFFUSION PARAMETERS OF THERMAL NEUTRONS IN HEAVY WATER (thesis). Francis Carter Cobb (North Carolina State Coll., Raleigh). 1961. 36p.

The diffusion parameters of thermal neutrons in heavy water were determined from a 1-Mev accelerator by measuring the decay of the leakage from the finite cylinder. A 26-channel time analyzer was used for measuring the leakage. Buckling was varied from 0.062 to 0.104 cm^{-2}. The diffusion coefficient obtained was $1.97 \pm 0.07 \times 10^{-5}\ cm^2/sec$. The diffusion cooling coefficient was $4.8 \pm 1.1 \times 10^{-5}\ cm^4/sec$. These values agree with those previously reported by investigators using other methods. (N.W.R.)

24265 (GAMD-398) A BUNNY INPUT CODE. F. T. Adler, V. Nather, and B. W. Roos (General Atomic Div., General Dynamics Corp., San Diego, Calif.). June 24, 1958. 15p.

A description is given of an IBM-650 code, written in the Wolontis interpretive routine, for calculating the two-group input quantities from the basic experimental and engineering data. Both the homogeneous and the heterogeneous systems are considered. The basic equations used for the computation of output data are given. (B.O.G.)

24266 NEUTRON FIRST COLLISION PROBABILITIES IN REACTOR PHYSICS. R. Bonalumi (Laboratori CISE, Segrate, Italy). Energia nucleare (Milan), 8: 326-36(May 1961). (In English)

Some original approximate methods are presented for calculating the various chances of collision in a concentric annuli cylindrical geometry. The problem of cell-to-cell interactions is also considered, by the generalization of a formula already known for solid rod fuel elements. Various applications of the collision probabilities are considered: among them, a synthetic calculation of the effective resonance surface in annuli fuel elements is offered, along with a formulation of the thermal utilization factor similar to Amouyal and Benoist's, except for the moderator single-collision treatment. (auth)

24267 EXACT SOLUTION OF A CRITICAL PROBLEM FOR A SLAB. Roman Zelazny (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw and Univ. of Warsaw). J. Math. Phys., 2: 538-42(July-Aug. 1961).

By using the Case method of expansion of the angular neutron distribution into series with respect to eigenfunctions of the plane Boltzmann equation, the critical problem of a slab was formulated. By means of symmetry considerations, the problem of boundary condition was reduced to one singular integral equation, which was treated by classical methods. This treatment has given an integral equation for expansion coefficients, which by means of a simple transformation can be reduced to a Fredholm type with a regular kernel, and an additional equation, which plays the role of an exact critical condition. The methods and results of numerical calculations will be published soon. (auth)

24268 TSCHEBYSCHEFF POLYNOMIAL APPROXIMATION METHOD OF THE NEUTRON-TRANSPORT EQUATION. Shin Yabushita (Kyoto Univ.). J. Math. Phys., 2: 543-9(July-Aug. 1961).

The Tschebyscheff polynomial approximation method of the neutron-transport equation is developed. The relations between the relaxation constants in this approximation and the positive roots of $T_{N+1}(\mu) = 0$ are derived. Using these relations, the necessary condition for reactor criticality is discussed. Application to Milne's problem leads to an explicit expression for extrapolated end point which is formally the same in the spherical-harmonics method. Numerical comparison of this method with the spherical-harmonics method verifies Conkie's conclusion [W. R. Conkie, Nuclear Sci. and Eng. 6, 260 (1959)] that, for weak absorbers, the spherical-harmonics method gives the values for extrapolated end point which is closer to the exact value than the T_N method does while, for strong absorbers, the T_N method gives closer value than the P_L method does. (auth)

24269 RESONANCE ABSORPTION IN A CYLINDRICAL FUEL ROD WITH RADIAL TEMPERATURE VARIATION. A. Reichel and A. Keane (Univ. of New South Wales, Sydney). J. Proc. Roy. Soc. N. S. Wales, 94: 215-25(1961).

When calculating the effective resonance integral for a cylindrical fuel rod in which allowances must be made for a radial temperature variation, it has been found that the appropriate average temperature to use is $T_s + 0.44 (T_c - T_s)$ where T_s and T_c are the surface and central temperatures respectively. (auth)

24270 FEW GROUP CALCULATIONS OF THERMAL NEUTRON TRANSPORT. M. Goldsmith and R. M. Cantwell (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 10: 207-18(July 1961).

One-velocity treatments of thermal neutron transport have proved inadequate whereas multigroup methods may be so time consuming as to become impractical. The few thermal-group calculations investigated lie between these extremes. Few-group calculations in typical power peaking and control rod worth studies are found to be both rapid and accurate, particularly when the rods are represented by

boundary conditions. Boundary conditions for use with the P-3 and double P-1 approximations are derived and discussed. (auth)

24271 DIFFUSION LENGTHS IN HETEROGENEOUS MEDIA. Joel H. Ferziger, George S. C. Wang, and P. F. Zweifel (Univ. of Michigan, Ann Arbor). Nuclear Sci. and Eng., 10: 285-94(July 1961).

An adaptation of Behrens' Method to the calculation of diffusion lengths in heterogeneous media is given. In all cases, the diffusion length in a medium containing adsorbing lumps can be related to the self-shielding factor of the lumps. Calculations are presented only for the simplest case given but the results display considerable disagreement with a frequently used formula. On grounds which are mainly intuitive, it is believed that this method is more accurate, particularly for large moderator to absorber ratio. Final conclusions cannot be drawn, however, until more experimental data become available. (auth)

24272 ON THE CRITICAL SCATTERING OF NEUTRONS. Hazime Mori and Kyozi Kawasaki (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 25: 723-5(Apr. 1961).

The critical scattering of neutrons by ferromagnetic materials is considered, in the neighborhood of the Curie temperature. The diffusion constant for the interaction is calculated in terms of spin operator correlation functions, using the Heisenberg model of the ferromagnet. The diffusion constant of Fe is calculated as an example. (T.F.H.)

24273 NEKOTORYE MATEMATICHESKIE ZADACHI NEITRONNOI FIZIKI. (Mathematical Problems in Neutron Physics). E. S. Kuznetsov, ed. Publishing House of the Moscow University, 1960. 223p.

Nine papers are included; separate abstracts have been prepared for each. (R.V.J.)

24274 THE MILNE PROBLEM FOR HALF-SPACE WITH ANISOTROPIC SCATTERING AND NEUTRON CAPTURE. L. M. Romanova. p.8-27 of "Nekotorye Matematicheskie Zadachi Neitronnoi Fiziki." Publishing House of the Moscow University, 1960.

The problem of half-space $z > 0$ uniformly filled with a non-absorbing substance that scatters neutrons at a steady rate according to the law $\sigma(\cos\phi) = (1/4\pi)\,[1 + gP_1(\cos\phi) + hP_2(\cos\phi)]$(where ϕ is the angle of scattering, g and h are constants, P_1 and P_2 are Legrange polynomials) is analyzed. A neutron flux directed along z is found in the scattering medium. The stationary distribution of neutron density in the medium and the angular distribution of neutrons escaping from a $z = 0$ plane are determined. (R.V.J.)

24275 APPLICATION OF VARIATIONAL PROCEDURES IN SOME GENERALIZED MILNE PROBLEMS. N. V. Ptitsyna. p.28-55 of "Nekotorye Matematicheskie Zadachi Neitronnoi Fiziki." Publishing House of the Moscow University, 1960.

It is shown that a variational procedure can be successfully applied to heterogeneous integral equations with infinite upper boundaries, including the generalized Milne problem for half-space. The approximate solutions of a variational procedure were correlated with precise boundary solutions. The experiment established the most pronounced order of error at the boundary, however, it diminished very rapidly. A simple appearance function, $q(z) = AE_2(z) + BE_3(z)$, was used in examining three problems. The order of error in determining the density did not exceed 0.3% for the classical Milne problem and 0.2% for the Milne problem with absorption. The order of error for extrapolated length, derived by a variational method, was 0.001%. (R.V.J.)

24276 ON MILNE SPHERICAL PROBLEM THEORY. M. V. Maslennikov. p.56-79 of "Nekotorye Matematicheskie Zadachi Neitronnoi Fiziki." Publishing House of the Moscow University, 1960.

Pure scattering events, $\beta(r) \equiv = \alpha(r)$, were analyzed. Assuming $\alpha(r) \equiv$ const at $r \geq r_0$, where r_0 is a constant, the existence and singularity of solution for the homogeneous spherical Milne problem was demonstrated. A certain asymptotic characteristic is given to the derived solution. Solutions were found for the problems assuming $\beta(r) \equiv \alpha(r)$, where $\alpha(r)$ has a limited variability at each limited interval and where $\beta(r)$ and $\alpha(r)$ are different locally limited functions. An analysis is made of the heterogeneous problem, and conditions for its non-trivial solution were confirmed. (R.V.J.)

24277 EXTRAPOLATED LENGTH AND DENSITY NEAR THE BOUNDARY IN MILNE SPHERICAL PROBLEM. T. A. Germogenova. p.80-119 of "Nekotorye Matematicheskie Zadachi Neitronnoi Fiziki." Publishing House of the Moscow University, 1960.

The magnitude of λ, considering absorption in the outer medium and density near the boundary, is sought by a variational method. Calculations are applied to the expressions of density n(r) at large r derived by Wiener and Hopf): $r(n)r = A_0 r + c_0$ at $\alpha = 0$ and $rn(r) = A\alpha \operatorname{sh} \nu r + c_1 e^{\nu r}$ at $\alpha \neq 0$. The case of $\alpha \neq 0$ required a more detailed study of limitation problems. An approximation was found for neutron density near the boundary in Milne half-space at $\alpha \to \infty$ and the asymptotic solution was investigated for a point block body at $\alpha \to 0$. (R.V.J.)

24278 NEUTRON ENERGY DISTRIBUTIONS IN ANISOTROPIC SCATTERING. A. I. Lebedev. p.120-42 of "Nekotorye Matematicheskie Zadachi Neitronnoi Fiziki." Publishing House of the Moscow University, 1960.

The energy distribution of neutrons in an infinite medium is investigated. The asymptotic expression for neutron distribution at scattering anisotropy in the gravity center system as well as in isotropy is not a function of energy and is equal $\psi_{as}(u) = (1/\xi)$ (where $\xi = \bar{u}$ is the mean logarithmic energy loss of one collision: $\bar{u} = \int_0^u u \cdot f(u)du$. The method is described for calculating $\psi(u)$ (collision function). Calculations are given for isotropic scattering. (R.V.J.)

Nuclear Properties and Reactions

24279 (AFOSR-171) ELECTRIC MONOPOLE TRANSITIONS IN COLLECTIVE NUCLEI. Technical Note No. 8. A. S. Reiner (Weizmann Inst. of Science, Rehovoth, Israel). Nov. 1, 1960. Contract AF61(052)-337. 29p. (AD-253343)

Electric monopole transitions were studied in nuclei with phonon and rotation-vibration spectra. Reduced transition probabilities were derived in a model which assumes incompressibility of nuclear matter and were compared with rates of competing E2 γ transitions. In the latter appreciable effects due to rotation-vibration interaction are included for the strong-coupling model. The derived branching ratios were essentially independent of nuclear parameters. In spite of a remarkable consistency of the model, as shown in various calculations of the zero-point fluctuation amplitude of the β vibrations, serious discrepancies in branching ratios were observed. Those were tentatively ascribed to the assumption of incompressibility of nuclear matter in the surface layer. (auth)

24280 (ANL-6358) PHYSICS DIVISION SUMMARY REPORT, APRIL–MAY 1961. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 50p.

Experimental Nuclear Physics. The left-right asymmetry in neutron scattering from Li^6, Li^7, Be^9, B, C^{12}, O^{16}, and Mg was measured at laboratory angles of 45 and 90° and neutron energies of 0.15 to 2.4 Mev. The polarization of neutrons in the $Li^7(p,n)$ reaction was determined. Angular correlation measurements in the reaction $Mg^{24}(p,p\gamma)$ at 10.7 Mev indicate that a direct-interaction mechanism predominates at forward scattering angles. Results of a molecular beam study are presented for the $^3P_1$ atomic state and dipole moment of Ge^{71}. Mass Spectroscopy. The fragmentation patterns and relative electron ionization cross sections of the lithium halide gases were measured. Theoretical Physics. The insensitivity of the sum of the magnetic moments of mirror nuclei to the spin-orbit coupling is shown to be due to the rotational nature of the wave functions. The exact treatment of pairing forces in nuclei is compared with the approximation of Kisslinger and Sorensen; results are given for Ni^{59}. The Aharonov-Bohm effect of magnetic fields in quantum mechanics is discussed. (D.L.C.)

24281 (ANU/P-223a) NUCLEAR E1 PEAK ENERGIES. J. H. Carver and D. C. Peaslee (Australian National Univ. [Research School of Physical Sciences], Canberra). [1960]. 20p.

The peak energies E_g of electric dipole giant resonances in photonuclear reactions exceed the shell model spacings E_s in the same nuclei, with the discrepancy $\delta = (E_g - E_s)/E_s$ being on the order of unity. A discussion is presented in which the δ is explained with the aid of sum rule expressions for the harmonic energy. It is shown that $(E_g - E_s)$ comprises mainly E_x, which is special to the E1 operator and to the charge exchange component of nuclear forces, and comparison with experiment gives a constant $E_x \cong 8$ Mev and thus a satisfactory account of δ. The use of a constant E_x allows an improved fit to the curve of $\int \sigma\, dE$ as a function of A. It is pointed out that the value of E_x is comparable in significance with the average nuclear potential V. The effective mass for the model ground state wave function is derived to be $M^*/M \geq 1$. (D.L.C.)

24282 (ANU/P-226) THE $B^{11}(p,\gamma\alpha)Be^8$ REACTION AND THE 9.63 MeV STATE OF C^{12}. A. G. Gregory (Australian National Univ. [Research School of Physical Sciences], Canberra). [1960]. 9p

The cross section for transitions between the 16.11- and 9.63-Mev states of C^{12} was determined to have an upper limit of 30% of that for ground state transitions. Theoretical formuals are given for the observable coincidence rate in the $B^{11}(p,\gamma\alpha)Be^8$ reaction at 163-kev bombarding energy as a function of γ detector acceptance angle for two positions of this detector. The possibility of determining the spin of the 9.63-Mev state of C^{12} is assessed. (D.L.C.)

24283 (ANU/P-228) PROTONS AND DEUTERONS FROM Ni^{58} BOMBARDED BY 14.9 MeV NEUTRONS. R. N. Glover and K. H. Purser (Australian National Univ. [Research School of Physical Sciences], Canberra). [1960]. 14p.

Energy spectra and angular distributions were measured for protons emitted from Ni^{58} which was bombarded by 14.9-Mev neutrons. The angular distributions indicate $l = 0$ and $l = 2$ transitions to unresolved levels near the ground state of Co^{58} for the direct interaction contribution. At proton energies below 6 Mev, the distributions are isotropic. Nuclear temperatures of 1.35 ± 0.03 and 0.50 ± 0.03 Mev were found for the reactions (n,pγ) + (n,pn) and (n,np), respectively. The total cross section for proton emission is 830 ± 70 mb, with partial cross sections being 430 mb (compound) and 60 mb (direct interaction) for (n,pγ) + (n,pn) and 340 mb for (n,np). The total cross section for the (n,d) reaction was measured to be 25 ± 6 mb. The deuteron angular distribution suggests unresolved transitions to the $7/2^-$ Co^{57} ground state and a new state at ~ 0.5 Mev. The presence of an $l = 1$ transition implies ~ 13% p-wave admixture in the Ni^{58} ground state configuration. (D.L.C.)

24284 (ANU/P-229) PROTONS AND DEUTERONS FROM Al^{27} BOMBARDED BY 14.9 MeV NEUTRONS. R. N. Glover and E. Weigold (Australian National Univ. [Research School of Physical Sciences], Canberra). [1960]. 14p.

Angular distributions of direct interaction proton groups corresponding to individual Mg^{27} levels were measured and found to agree with theory. Nuclear temperatures of 1.55 ± 0.15 and 0.49 ± 0.02 Mev were found for the reactions (n,pγ) + (n,pn) and (n,np) respectively. Cross sections for proton emission were determined to be 273 ± 20 mb (total), 89 mb compound and 27 mb direct ((n,pγ) + (n,pn)), and 157 mb ((n,np)). Spins are assigned to several Mg^{27} levels. Angular distributions of deuteron groups corresponding to Mg^{28} levels were measured, and reduced widths were extracted and found to agree with the rotational model. (D.L.C.)

24285 (BNL-5516) CONSERVATION OF SPIN AND PARITY IN THE ALPHA DECAY OF O^{16}. P. F. Donovan (Bell Telephone Labs., Inc., Murray Hill, N. J. and Brookhaven National Lab., Upton, N. Y.); D. E. Alburger (Brookhaven National Lab., Upton, N. Y.), and D. H. Wilkinson (Oxford Univ. Clarendon Lab.). [1961]. 6p.

A limit on the width for α decay of the 2- state at 8.88 Mev in O^{16} was determined. Levels in O^{16} were populated by β^- decay of N^{16}, and the energy spectrum of the consequent delayed α particles was examined for evidence of α decay of the 8.88-Mev level. A limit on F^2 of $\leq 6.6 \times 10^{-13}$ is suggested. (auth)

24286 (CEA-1881) ETUDE, PAR RADIOACTIVITE, DES NIVEAUX DE ^{93}Mo ET ^{95}Mo ET ESSAI DE MISE EN EVIDENCE DE LA SOUS-COUCHE $2d_{\frac{5}{2}}$. (Radioactivity Study of Mo^{93} and Mo^{95} Levels and Test of Evidence for Position of $2d_{\frac{5}{2}}$ Subshell). Christiane Levi (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 116p.

Thesis submitted to Univ. of Paris.

The decay schemes of Tc^{93} and Tc^{95} were studied to determine the spins of Mo^{93} and Mo^{95} levels, and especially the position of the single-particle level 1 g 7/2. A large spacing was found between the neutron shells 2d 5/2 and 1 g 7/2 like that observed first in Mo^{97}. As the subshell 2d 5/2 is so far from its neighbors, it appeared that subshell effects could perhaps be discovered in the systematics of separation energies and beta-decay energies. Such effects were found. (auth)

24287 (CF-60-11-8) COMPILATION OF REQUESTS FOR NUCLEAR CROSS SECTION MEASUREMENTS. John A. Harvey, comp. (Oak Ridge National Lab., Tenn.). Nov. 1960. 40p.

The requests are tabulated according to the element with information included as to the type of measurements desired, energy range, priority, and accuracy. An outline is given of the neutron cross section problems justifying major efforts. Procedures for making and screening the requests are described. (B.O.G.)

24288 (CF-61-6-87) MULTIGROUP NEUTRON CROSS SECTIONS. C. W. Nestor (Oak Ridge National Lab., Tenn.). June 23, 1961. 61p.

Tables of multigroup neutron cross sections for the IBM-704 program GNU are presented for a large number of elements, isotopes, and reactor configurations. The tables comprise the revised edition of CF-60-3-35, incorporating some new data for U^{235} and including some data inadvertently omitted from the earlier compilation. (D.L.C.)

24289 (GEAP-3496) GAMMA ABUNDANCE IN THE RADIOACTIVE DECAY OF Kr-85. B. F. Rider and J. P. Peterson, Jr. (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Aug. 1, 1960. 36p.

The gamma branching ratio of Kr^{85} decay was redetermined with absolute gamma measurements and mass spectrometric measurements supported by internal beta counting and gas chromatography. The 0.513 Mev gamma-to-beta ratio was measured to be 0.0036 ± 0.0008, significantly lower than the previous value of 0.0065 ± 0.0015. (D.L.C.)

24290 (IA-635) ON THE X-RAY DEFICIENCY IN MESONIC ATOMS. Y. Eisenberg (Weizmann Inst. of Science, Rehovoth, Israel) and D. Kessler (Israel. Atomic Energy Commission, Rehovoth). May 1961. 32p.

An analysis of π-mesonic atoms, based upon cascade calculations, taking into account the known processes of radiation, Auger-transitions, and nuclear absorption is presented. This analysis is intended to provide a deeper insight into the unsolved problem of the deficiency of x rays in mesonic atoms. It is shown that the π-mesonic L x ray yields (for $Z \leq 20$) are quite insensitive to the strength of nuclear absorption and depend only upon the chosen initial meson population of the higher levels. Similarly, the ratios of basic (K_α, L_α etc.) to higher x-ray yields, both for μ and π mesons, depend strongly on the initial distribution. The best agreement between the calculations and experiment was obtained for a "modified statistical" initial population of the form: $(2l + 1) \cdot e^{al}$ with $a = 0.2$ in the $n = 14$ level. From the existing experimental data on π-mesonic K x rays, the mean life of the π-meson in nuclear matter was deduced: $\tau_c = 2.75 \times 10^{-23}$ sec. Within the framework of the present theory it was impossible to account for the x-ray difficiency in the light atoms. However, it is shown that the quantum loss as a function of energy is different for π- and μ-mesonic atoms, and therefore it is very probably due to a real physical effect. Furthermore, by comparing the predicted Auger electron yields with the experimental data, any hypothetical simple Auger process in which the full energy of the "missing" quantum is given to a single electron can be ruled out. (auth)

24291 (ORO-435) 14.5 MEV NEUTRON-INDUCED FISSION OF U^{238} (thesis). Knox McLeod Broom, Jr. (Arkansas. Univ., Fayetteville). 1961. Contract AT(40-1)-277. 50p.

Mass yields for A = 89 to 140 were measured for U^{238} fissioned by 14.5-Mev neutrons. Comparison is made between the experimental results and those of Thode and Kuroda for spontaneous fission of U^{238}. Methods of calculating fission yields are discussed and their results compared with experimental results. (D.L.C.)

24292 (ORO-436) TABLE OF RADIOACTIVE SPECIES OBTAINABLE FROM NATURAL ELEMENTS BY REACTIONS (n,n'), (n,γ), (n,p), (n,2n), (n,np), (n,t), (n,He^3), (n,α) AND (n,n'α). J. Kantele and R. Rogers, comps. (Arkansas. Univ., Fayetteville). June 1961. Contract AT(40-1)-277. 25p.

A list of radioisotopes obtainable by neutron reactions in the 0.01-sec to 30-day half-period range is presented and arranged according to increasing half period. The beta and gamma energies are also reported where available. The purpose of the data is to facilitate neutron spectroscopy with 14-Mev neutrons. (D.L.C.)

24293 (PAN-224/VII) ON THE ANGULAR MOMENTUM WEIGHT FACTOR IN THE STATISTICAL THEORY OF MULTIPLE PARTICLE PRODUCTION. PART II. Z. Koba (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Apr. 1961. 10p.

Based on the relations presented previously, an asymptotic expansion (for $n \gg 1$ and $El_i^2 \gg l_i^2$) of the angular momentum weight factor zn of the statistical theory of multiple particle production was worked out. (auth)

24294 (TID-13123) BASIC RESEARCH WITH HIGH ENERGY ELECTRONS AND X-RAYS PRODUCED BY A 300 MEV SYNCHROTRON. Annual Progress Report. (Purdue Research Foundation, Lafayette, Ind.). June 30, 1961. Contract AT(11-1)-123. 32p.

The work on the changeover to 1-Mev injection into the 300-Mev synchrotron is described; beam intensities were obtained which were ~3 times higher than the highest intensity prior to the injection change. Some experimental results obtained with the synchrotron are reported and proposed experiments outlined. A preliminary result of photomeson (π^+) production experiments is presented for Al^{27}. The development of a carbon plate spark chamber for determining the polarization of photoprotons is described. The purpose and possibilities of the high-energy program on the $\pi^\pm$ + p reactions are described. Theoretical studies in progress are described; preliminary results are reported for potential boundary condition model analysis of p-p scattering and for s-wave partial amplitudes of p-N scattering. (D.L.C.)

24295 (TID-13165) DETERMINATION OF α FOR U^{235} IN THE INTERMEDIATE ENERGY SPECTRUM BY ANALYSIS OF URANIUM FUEL FROM A Be MODERATED INTERMEDIATE SPECTRUM LATTICE. E. B. Fehr, E. C. Hansen, D. G. Miller, and F. M. Rourke (Knolls Atomic Power Lab., Schenectady, N. Y.). [1961?]. Contract W-31-109-Eng-52. 9p.

The value for the capture-to-fission ratio α for U^{235} for intermediate-energy neutrons was determined by analysis of depleted uranium fuel from a Be-moderated and -reflected lattice. The radiochemical method of analysis is outlined. The results are compared with the 1947 KAPL results and with the work of S. Oleska. (D.L.C.)

24296 (TID-13197) THE DECAY OF In^{110m}. W. G. Smith (Purdue Univ., Lafayette, Ind. Physics Dept.). [nd]. 18p.

The K-L conversion electron energy differences of 2 transitions with energies equal to 0.1131 and 0.1200 Mev were determined in a permanent magnet spectrograph. These experimental differences (0.02265 Mev) are in agreement only with the $K\text{-}L_I$ energy difference of cadmium. Therefore neither of these transitions can follow an isomeric transition in In^{110m}. Energy measurements of two other transitions (0.4614 and 0.5840 Mev) combined with the 0.1200-Mev transition energy measurement show that the 0.1200- and 0.4614-Mev transitions are not in cascade, and in parallel with the 0.5840-Mev transition, as proposed by Yoshizawa. (auth)

24297 (UCRL-9648) THE MAGNETIC PROPERTIES OF DEFORMED NUCLEI (thesis). Lung-wen Chiao (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1961. Contract W-7405-eng-48. 53p.

It is shown that the magnetic moments of odd-A deformed nuclei can be interpreted in terms of the independent-particle model with interconfigurational mixing due to the very-short-range residual forces. The latter are implied by using the empirically reduced spin gyromagnetic ratios. The effects of these residual forces on the collective gyromagnetic ratios g_R are discussed in terms of pair correlation. The effect of particle-rotation interaction on the magnetic moment and the collective gyromagnetic ratio are shown. The g_R values are obtained from the magnetic moments and the matrix elements for M1 transitions in this band. It is found that these mechanisms give a satisfactory account of the collective gyromagnetic ratio of Dy^{161}, Ho^{165}, Er^{167}, and Hf^{179}. (auth)

24298 (WAPD-T-1309) CALCULATING ENERGY RELEASED BY FISSION PRODUCTS. K. Shure and D. J. Dudziak (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Mar. 1961. Contract AT-11-1-GEN-14. 12p.

A review was made of available information concerning the energy released from fission products for cooling times from 10^{-1} to 10^{9} sec. The information is applicable to the calculation of the total energy release associated with the decay of fission products and to the determination of the total gamma-ray energy released and its spectral distribution. (auth)

24299 (AEC-tr-4651) FIRST EXCITED LEVELS OF PLATINUM 190. Jerzy Jastrzebski and Pierrette Kilcher (College de France, Orsay. Laboratoire de Physique Nucléaire). Translated by Richard P. Metcalf. [1961]. 9p.

The decay of Au^{190} was investigated with an intermediate image β ray spectrometer and scintillation techniques. The ratio r = B(E2; 2′ → 2)/B(E2; 2′ → 0) was determined by measuring the conversion electron intensities. Comparison of energies for the first three excited levels and the r value is given for different even-even Pt nuclei. (auth)

24300 (AEC-tr-4658) DISINTEGRATION OF MERCURY 192. Jerzy Jastrzebski and Pierrette Kilcher. Translated by R. P. Metcalf (Oak Ridge National Lab.) from Compt. rend. 252: 2221-2(Apr. 10, 1961). 4p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 20165.

24301 (AEC-tr-4743) SECONDARY ELECTRONS AND -PHOTONS OF μ-MESONS IN SOLID MATERIALS. K. Ott and H. Preuss. Translated from Z. Naturforsch., 12a, 451-65(1957). 32p.

The internal energy spectra of the electrons and photons accompanying the μ meson components at sea level were calculated for C, Fe, and Pb layers having a thickness of from 0 to 50 gm/cm^2 with energies from 0 to 100 Mev. (auth)

24302 (AEC-tr-4744) THE PRODUCTION OF IMPACT-ELECTRONS (KNOCKED-OUT ELECTRONS) BY PASSING HIGH-ENERGY μ-MESONS THROUGH IRON AND LEAD. U. Pfeiffer. Translated from Z. Naturforsch., 12a, 148-53(1957). 11p.

The numerous impact processes taking place on the electrons of a material when high energy μ mesons pass through dense layers of this material are discussed. The fraction of Compton electrons of the secondary electrons observed in a Wilson cloud chamber to leave iron and the effect of back-scattering on the number of electrons leaving the material in the direction of travel of the mesons in both iron and lead were determined. The angular distributions of the electrons after leaving the material were examined as a function of energy. The evaluation of the cloud chamber photographs was augmented by more accurate measurements with a counter-tube apparatus. (M.C.G.)

24303 (JPRS-4703) FERMI'S UNIVERSAL THEORY OF INTERACTION AND NUCLEAR CAPTURE OF MINUS MU-MESON. Kuang-chou Chou and V. Mayevsky. Translated from Wu Li Hsueh Pao, 15: 377-88(July 1959).

The Fermi Universal Theory of Interaction is discussed in a study of nuclear capture of μ^- mesons. Negative muon capture by a proton was first considered. The existence of a large anomalous magnetic moment in the nucleus was observed. The effect of this β-magnetic moment on the capture process was determined to be about 20%. General formulas for capture probability and the angular relationships between polarized and unpolarized neutrons and polarized μ^- mesons were studied. Formulas for the possibility of μ^- meson capture by protons were developed. Capture by nuclei and especially the radon nucleus is discussed. (M.C.G.)

24304 (UCRL-Trans-547(L)) PHOTOELECTRON EMISSION. (Elektronnie Umnozhiteli). Translated by Esther Goldberg from a publication of the State Publishing House for Technical-Theoretical Literature, Moscow, Chapter I, 17-62, 1957. 48p.

Information is presented on behavior of electrons in semiconductors and dielectrics, and on the operation of discharge. Photoeffect basic laws are examined followed by discussions of spectral and integral photocathode sensitivity, selective photoeffects, and photoeffects of complex cathodes. Other information is presented concerning light and electrical curves of complex cathodes. (J.R.D.)

24305 AN ATTEMPT TO CALCULATE THE REACTION $^{14}N(d,p)^{15}N$ BY THE BORN FIRST APPROXIMATION. Ryszard Kofodziejski (Inst. of Theoretical Physics, Warsaw). Acta Phys. Polon., 20: 275-80(1961). (In English)

The differential cross sections for $N^{14}(d,p)N^{15}$ are calculated for the case in which the 2S level of N^{15} is formed. A variational method is applied and the angular distribution of the emerging protons is calculated by the Born first approximation for four values of the range of the Yukawa potential. The proton-target nucleus forces are found to be at least as important as the neutron-target nucleus forces. The calculated angular distributions for the emerging protons and the calculated absolute values of the differential cross sections are entirely different from the experimental values. The calculations suggest that in stripping reactions the capture process takes place only on the edge of the nucleus. (auth)

24306 GAMMA-VIBRATIONAL LEVELS IN Er^{166}. E. Bozek, H. Niewodniczanski, S. Ogaza, S. Szymczyk, T. Walczak, I. A. Yutlandov (Polish Academy of Sciences, Krakow). Acta Phys. Polon., 20: 351-6(1961). (In English)

Directional correlation measurements in Er^{166} for the 779.8–80.59 kev gamma-gamma cascade were performed. The values I = 3 and K = 2 for the energy level 860.2 kev were determined. The deformation of the Er^{166} nucleus in the ground state and in the gamma-vibrational state, as well as the rotational-vibrational interaction of energy levels in this nucleus, are discussed. (auth)

24307 THE TENSOR INTERACTION AND NUCLEAR MATTER. Bruce L. Scott (Univ. of Southern California, Los Angeles) and Steven A. Moszkowski. Ann. Phys. (N. Y.), 14: 107-19(July 1961).

The separation method of Moszkowski-Scott has been applied to the calculation of the properties of nuclear mat-

ter using two different nucleon-nucleon potentials, both in reasonable agreement with two-body data. Calculations with the potential of Brueckner–Gammel gave E/A = –14.2 Mev at an equilibrium density corresponding to $k_f = 1.5\ f^{-1}$. The difference from the results of B and G may be caused by slow convergence of the series (especially in the triplet-even state where the tensor interaction has a large second order contribution). An important factor in obtaining nuclear saturation is shown to be the weakening of tensor interaction effects by the Fermi sea. Evidence for this may also be seen from the results obtained using a different two nucleon potential which, however, still gives good fits to two body data. The potential chosen has a much weaker tensor component and shows no sign of saturation at normal densities (at $k_f = 1.5\ f^{-1}$, E/A = –23.4 Mev). The difference in the two results appears to be much larger than can be accounted for either by higher order terms or by differences in the phase shift approximation to the reaction matrix. (auth)

24308 s- AND p-WAVE NEUTRON SPECTROSCOPY. PART V. LEVEL SPACINGS IN HEAVY NUCLEI. H. W. Newson, J. H. Gibbons, H. Marshak, E. G. Bilpuch, R. H. Rohrer, and P. Capp (Duke Univ., Durham, N. C.). Ann. Phys. (N. Y.), 14: 346-64(July 1961).

Total neutron cross sections were measured for natural rubidium and thallium and for the separated isotopes Pb^{208}, Pb^{207}, Pb^{206}, Tl^{203}, and Rb^{85}. Approximate s-wave resonance spacings were estimated for Pb^{207}, Y^{89}, Rb^{87}, Rb^{85}, Tl^{203}, and Tl^{205}. $D_0 = D_J\,(2J + 1) = 2D_S\,(2I + 1) = 50$, 24, 8, 4, and 30 kev, respectively, where D_s is the average (s-wave) level spacing for all channels. The spacings (D_0) of Pb^{206} and Pb^{208} were found to be of the order of hundreds of kev; there is also evidence that resonance spacings are very wide for Sr^{86} and Ba^{136}. It is concluded that, in all compound nuclei with a neutron number slightly less than the magic numbers 50, 82, and 126, the resonance spacings are usually not much less than when the magic number is exceeded slightly. Since neutron excitation energies of these sub-magic nuclei are higher than the average, the observed wide level spacings below the magic numbers must be due to the properties of the nearly closed shells and can not possibly be caused only by low excitation energy of the compound nucleus. In considering these comparisons it is shown that, for s-wave resonances, the relation $D_J = D_0/(2J + 1)$ is a useful approximation in that a plot of D_0 is a much less erratic function of A than is the observed spacing. The Bethe-Hurwitz effect, i.e., the influence on resonance spacing (apart from the 2J + 1 factor) of an unpaired nucleon in the target nucleus is also discussed. It is estimated that $\alpha \geq 30$ in the equation $D_0(0)/D_0(W) = \exp\,(\alpha W)^{1/2}$ where $D_0(0)$ is the energy and spin independent spacing parameter, and W is the excitation energy of the compound nucleus. (auth)

24309 s- AND p-WAVE NEUTRON SPECTROSCOPY. PART VI. LEVEL DENSITY AND NEUTRON EXCESS. H. W. Newson, E. G. Bilpuch, F. P. Karriker, L. W. Weston, J. R. Patterson, and C. D. Bowman (Duke Univ., Durham, N. C.). Ann. Phys. (N. Y.), 14: 365-86(July 1961).

Neutron total cross-section curves for Ca^{40}, Ca^{44}, Cr^{50}, Cr^{52}, Cr^{54}, Fe^{54}, and natural Fe, Ti, and Cr have been measured in the kev region. Level spacings have been estimated for the predominant isotope in each of the samples measured, and are compared to similar data found for even N, odd Z targets. After correcting for differences in the angular momenta and excitation energies, it is found that on the average (between A = 35 and 60) $d\,[\ln D_0(6\ \text{Mev})] = (\partial \ln D_0/\partial Z)dZ + (\partial \ln D_0/\partial N)\,dN \simeq 0.3\,dZ - 0.3\,dN$, and hence D_0(6 Mev) is proportional to $\exp -0.3(N - Z)$. D_0 (6 Mev) is the spin and energy independent spacing parameter. Except for slight signs of a maximum at N = 28, D_0(6 Mev) appears (between A = 35 and 60) to be strongly dependent only on the neutron excess, N – Z, and not on N, Z, or A; uncertainties in the correction for excitation are such that it is likely that the absolute value of the exponent, 0.3 (N – Z) is a lower limit. Isotopic and J^π assignments of many resonances in the natural fluorine and chromium cross-section curves are suggested. (auth)

24310 s- AND p-WAVE NEUTRON SPECTROSCOPY. PART VII. WIDTHS OF NEUTRON RESONANCES. E. G. Bilpuch, K. K. Seth, C. D. Bowman, R. H. Tabony, R. C. Smith, and H. W. Newson (Duke Univ., Durham, N. C.). Ann. Phys. (N. Y.), 14: 387-418(July 1961).

Neutron reduced widths Γ_n^0 and Γ_n^1 are reported for about 200 resonances observed in neutron total cross sections of $Ca^{40,44}$, Ti^{48}, $Cr^{50,52,54}$, $Fe^{54,56}$, $Ni^{58,60}$, Sr^{88}, Y^{89}, Sn^{124}, Te^{130}, $Ba^{136,138}$, and $Pb^{206,207,208}$ in the energy region 1 to 200 kev. Average parameters $\overline{\Gamma_n^0}$, $\overline{\Gamma_n^0}/D$, and $\overline{\Gamma_n^{(1)}}/D$ have been derived and the Wigner distribution for local spacings and the Porter-Thomas distribution for reduced widths are verified for the resonances in the even-even nuclei Ca^{40}, Fe^{56}, Ni^{58}, and Ni^{60}. A simple method of area analysis which is less tedious and time consuming than the method reported before in Part III is also described. (auth)

24311 DYNAMIC NUCLEAR POLARISATION BY THERMAL CONTACT BETWEEN SPIN SYSTEMS. Maurice Goldman and Andre Landesman (Centre d'Etudes nucleaires, Saclay, France) Compt. rend., 252: 263-5(Jan. 9, 1961). (CEA 1897). (In French)

A new method of dynamic nuclear polarization is studied. It makes possible polarizations which are, in the case of paradichlorobenzene, eight times greater than the maximum predicted theoretically for the "solid-effect" method. (auth)

24312 EVIDENCE OF AN INTERFERENCE EFFECT BETWEEN TWO RESONANCES OF PRASEODYMIUM-141 FOR THE SCATTERING OF 215- AND 232-ev NEUTRONS. Jean Julien. Compt. rend., 252: 3233-4(May 24, 1961). (In French)

The inclusion of an interference term between two resonances in the scattering cross section permits the same spin value to be attributed to these two resonances. (tr-auth)

24313 ABSOLUTE MEASUREMENT OF THE ENERGY OF THE MOST IMPORTANT NATURAL ALPHA EMITTERS. Albrecht Rytz. Helv. Phys. Acta, 34: 240-64(1961). (In German)

With a 180° spectrograph in a large permanent magnet, the alpha energies of Po^{210}, Po^{212}, Po^{214}, Bi^{212}, Bi^{211}, Ra^{223}, Rn^{219}, and Po^{215} were determined absolutely. The magnetic field was measured by proton resonance and the orbit diameter was compared with a standard metric rod. (tr-auth)

24314 A SIMPLE STUDY OF THE NUCLEAR SELF-CONSISTENT FIELD PROBLEM. N. V. V. J. Swamy (Karnatak Univ., Dharwar, India). Indian J. Phys., 35: 170-6(Apr. 1961). (In English)

Using assumed nucleon-nucleus potentials and a phenomenological nucleon density distribution, a Hartree-type self-consistent field calculation is carried out for O^{16}. Calculations three cycles indicate that the nucleus collapses in each cycle if only a pure central attraction of the Yukawa type is assumed to exist between the nucleons. Introduction of a repulsive core, other than the usual hard sphere type, leads to the conclusion that angular momentum dependent potentials must be used in order to obtain convergence in

successive cycles and adequate binding energy of the nucleus. An estimate is made of the correlation length of the resulting non-local potential, and of the effective mass as a function of position. (auth)

24315 RADIOCHEMICAL STUDIES OF FISSION PRODUCT LANTHANUM AND LANTHANIDES. II. FISSION OF URANIUM INDUCED BY 170 MEV PROTONS. A. C. Pappas (Univ. of Oslo) and J. Alstad. J. Inorg. & Nuclear Chem., 17: 195-205(June 1961). (In English)

The fission yields of isotopes of La and lanthanides was measured in fission of natural U induced by 170-Mev protons. The measured cumulative yields of 13 nuclides and independent yields of 5 nuclides are given. These yields were used to evaluate the charge distribution in the mass region studied. The experimental data seem to give better support to the equal-charge-displacement than to the unchanged-charge-distribution hypothesis. The apparent fissioning nuclide has a low mass number of about 230. A survey of the widths of charge distribution curves for symmetric and asymmetric division with energy suggests that symmetric and asymmetric fission modes are different reactions and should be considered separately in any treatment of fission phenomena. (auth)

24316 THE YIELD RATIO OF THE ISOMERIC PAIR ^{197m,197}Hg FORMED BY ^{197}Au(d,2n)^{197}Hg REACTION. S. Abecasis and S. J. Nassiff (Comision Nacional de la Energia Atomica, Buenos Aires). J. Inorg. & Nuclear Chem., 17: 206-9(June 1961). (In English)

The yield ratio of the isomeric pair formed by the reaction Au^{197}(d,2n) was measured at different deuteron energies between 9 and 26 Mev. The results are briefly discussed. (auth)

24317 INELASTIC SCATTERING OF DEUTERONS FROM C^{12}, Mg^{24} AND Ni^{60}. Yoshihide Ishizaki (Tokyo Univ.). J. Phys. Soc. Japan, 16: 1056-65(June 1961). (In English)

The absolute differential cross sections for the inelastic scattering of deuterons leading to the first excited state of C^{12} are measured at deuteron energies of 14.7, 15.9, and 18.1 Mev. Similar measurements are made on Mg^{24} at 15.9 and 17.5 Mev and on Ni^{60} at 18.1 Mev. Deuterons are detected with thin CsI crystals, so that protons from (d,p) reactions do not contribute to the cross section. The energy resolution of the detectors is less than 4 percent. The obtained angular distributions show a prominent peak at small angles in all cases, and the cross sections decrease at the extremely foward angles. Therefore it is not necessary to take into account the electric interaction to explain the reactions. The angular distributions are observed to have an unusual energy dependence. The data are analyzed with the nuclear interaction theory. When the theoretical curve is normalized to the measurement at the forward peak, disagreement occurs between the theoretical and experimental curves at other places, which shows the need of modifying the theoretical calculations with the distorted wave approximation and of taking a proper optical potential to explain the reaction. (auth)

24318 ANOMALIES IN THE SCATTERING OF ALPHA PARTICLES BY CARBON. Takashi Mikumo (Tokyo Univ.). J. Phys. Soc. Japan, 16: 1066-76(June 1961). (In English)

Angular distributions of elastic and inelastic (Q = −4.43 Mev) scattering of alpha particles by the carbon nucleus are measured at eight alpha energies between 27.0 and 35.5 Mev. Angular distributions for both elastic and inelastic alphas show variations with bombarding energy that cannot be explained by simple direct interaction theories. Anomalies appear in the angular distributions for alpha energies in the neighborhood of 30 Mev. Also, in the excitation energy near 30 Mev in the compound system, some resonances are found in the elastic excitation function and in the integrated cross section for the inelastic scattering. Even at such high excitation energies the effect of the compound system cannot be ignored. (auth)

24319 He^3-ALPHA SCATTERING. Ren Chiba, Homer E. Conzett, Haruhiko Morinaga, Naoshi Mutsuro, Katsufusa Shoda, and Motoharu Kimura (Tohoku Univ., Sendai). J. Phys. Soc. Japan, 16: 1077-85(June 1961). (In English)

Differential cross sections for scattering of He^4 by He^3 are measured at E_α = 27.7, 28.5, 29.4, 30.0, 32.0, 33.4, 34.7, 36.5, 38.4, and 41.0 Mev using a scintillation counter spectrometer, at center of mass angles from ~30 to ~150°. Three distinct minima are found, at about 45, 100, and 140°. The absolute cross section and the pattern of the angular distribution show no appreciable change in the energy range investigated: there is thus no sharp resonance in the He^3 + He^4 system corresponding to an excited state of Be^7 between 13.4 and 19.2 Mev. Differential cross sections of the protons from $He^3(\alpha,p)Li^6$ Li^{6*} are observed. Differential cross sections of alpha-alpha scattering are also measured at E_α = 33.5 and 35.5 Mev. (auth)

24320 ANGULAR CORRELATION OF THE Mo^{95} GAMMA-GAMMA CASCADES. Atsushi Aoki (Kyoto Prefectural Univ.). J. Phys. Soc. Japan, 16: 1086-91(June 1961). (In English)

The directional correlation and the polarization-direction correlation of the 838 kev-204 kev and 584 kev-204 kev gamma-gamma cascades in Mo^{95} are measured. It is found that the spin of the 788 kev level is $\frac{1}{2}$, and that of the 1042 kev level is either $\frac{1}{2}$ or $\frac{3}{2}$. The branching ratio of the Tc^{95} positron decay is also obtained as 0.4%. (auth)

24321 ANGULAR DISTRIBUTION OF (α,p) REACTIONS IN SOME LIGHT NUCLEI. Michiya Kondo, Takashi Yamazaki, and Shotaro Yamabe (Osaka Univ.). J. Phys. Soc. Japan, 16: 1091-8(June 1961). (In English)

The angular distributions of the proton groups corresponding to the lower states of the residual nuclei from the reactions $C^{12}(\alpha,p)N^{15}$; $F^{19}(\alpha,p)Ne^{22}$; $Al^{27}(\alpha,p)Si^{30}$; and $Si^{28}(\alpha,p)P^{31}$ are measured using 22.5 ± 0.2 Mev alpha particles. The angular distributions of the $C^{12}(\alpha,p)N^{15}$ reaction are energy dependent. At 20.6 Mev a steep rise in the forward angles is observed, but at 22.2 Mev a steep rise appears in the backward angles instead of the forward angles. The angular distributions of the $F^{19}(\alpha,p)Ne^{22}$ reaction are peaked in the backward angles. The angular distributions of the $Al^{27}(\alpha,p)Si^{30}$ and the $Si^{28}(\alpha,p)P^{31}$ reactions show diffraction-like patterns and are interpreted with Butler's direct interaction theory. (auth)

24322 INVESTIGATION OF THE REACTION $Sc^{45}(n,p)Ca^{45}$. II. DETERMINATION OF THE CROSS SECTION FOR NEUTRONS OF THE FISSION SPECTRUM. R. Münze, K. Jantsch, and O. Hladik (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 4: 293-6 (Apr. 1961). (In German)

The determination of the cross sections of Ca^{45} formation by an (n,p) reaction is reported. The Ca^{45} formed by irradiation with neutrons of approximate fission spectrum was isolated from the scandium target and determined by 2π particle counting. The effective flux of fast neutrons was determined by sulfur monitors so that a calculation of the integral cross section was possible. The value found was compared with the theoretical estimation by Hughes. (tr-auth)

24323 SCATTERING BY Si^{28} OF PROTONS OF ENERGY 10.0-12.3 MeV. A. V. Cohen and J. A. Cookson (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Phys., 24: 529-34(1961). (In English)

The excitation curve for inelastic scattering of protons in the energy range 10.0 to 12.3 Mev shows considerable structure. Angular distributions, both of this reaction and the elastic process, were determined at two energies, and the elastic results are discussed in terms of the optical model. (auth)

24324 EVIDENCE FOR THE EXISTENCE OF ROTATIONAL LEVELS IN ALL EVEN NUCLEI. C. A. Mallmann (Argonne National Lab., Ill.). Nuclear Phys., 24: 535-75(1961). (In English)

A theory of rotations of even nuclei is developed which is more general than the one based on the hydrodynamical model. It is assumed that the rotational motion can be treated adiabatically and that the three effective moments of inertia and the two effective quadrupole moments are independent parameters. A small centrifugal distortion of the rotor is added as a correction term. The theoretical predictions for energy levels and gamma transition probabilities are compared with experimental results for nuclei with $40 \leqq A \leqq 250$ and good agreement is obtained. The trends of the effective moments of inertia and effective quadrupole moments as a function of A are given. (auth)

24325 THE VIBRATIONAL QUADRUPOLE EXCITATION MODEL AND NON-AXIAL ROTATOR MODEL. D. P. Grechukhin (I. V. Kurchatov Atomic Energy Inst., Academy of Sciences, Moscow). Nuclear Phys., 24: 576-600(1961). (In English)

To elucidate the experimental possibilities of checking the non-axial rotator model and the vibrational model for nuclei with nearly equidistant spectra, a detailed comparison was performed of the predictions of these models for the following quantities: 1) the probabilities of E0-, E2-, E4-, and M1-transitions of nuclei; 2) isotopic and isomeric shifts of the levels of atomic electrons; 3) quadrupole moments of nuclei in excited states. Experiments are proposed to check up the non-axial rotator model for nuclei in the region of the transition from the equidistant spectrum to that of the axial symmetrical rotator. (auth)

24326 GAMMA-GAMMA DIRECTIONAL CORRELATION IN Ba^{136} AND Mo^{94}. H. Bernstein and H. H. Forster (Univ. of Southern California, Los Angeles). Nuclear Phys., 24: 601-6(1961). (In English)

The gamma-gamma directional correlation was measured for the 1.065 to 0.830 Mev gamma cascade in Ba^{136} and for the 0.700 to 0.874 Mev cascade in Mo^{94}. The experimental correlation is compatible with either a $4^+(Q)2^+(Q)0^+$ or a $2^+(D+Q)2^+(Q)0^+$ level sequence for the lowest states in either nucleus. A 2^+ assignment for the second excited state leads to a predominantly M1 transition between the second and first excited state, e.g., the quadrupole content in Ba^{136} is $2.7 \pm 0.6\%$, that of Mo^{94} is $4.4 \pm 0.4\%$. (auth)

24327 (N-Z) DEPENDENCE OF RADIATIVE DEUTERON CAPTURE CROSS-SECTIONS. J. H. Carver (Australian National Univ., Canberra) and G. A. Jones. Nuclear Phys., 24: 607-13(1961). (In English)

Induced radioactivity methods were used to determine the radiative deuteron capture cross sections for Ni^{58} and Cr^{54} in the range of deuteron energies 3.5 to 4.5 Mev. When combined with previous measurements of the $Zn^{64}(d,\gamma)$ cross section these results give the (d,γ) cross sections for nuclei with $N-Z = 2$, 4, and 6. If there is a strong contribution to the cross sections from direct electric dipole capture they should be proportional to the deuteron penetration factor and to $(N-Z)^2/A^2$. No evidence is found for such a direct contribution. For $Ni^{58}(N-Z = 2)$ at a deuteron energy of 4.5 Mev, $\sigma(d,\gamma) = 61 \pm 9$ μb and $\sigma(d,n) = 85 \pm 12$ mb. For Cr^{54} $(N-Z = 6)$ at a deuteron energy of 4.5 Mev $\sigma(d,\gamma) = 295 \pm 45$ μb and $\sigma(d,p) = 75 \pm 12$ mb. These cross sections are consistent with an interpretation in terms of the statistical decay of a compound nucleus, the radiative probability being determined from photodisintegration data. (auth)

24328 THE MAGNETIC SPECTROGRAPH DATA ON LEVEL DENSITIES OF LIGHT NUCLEI. N. MacDonald and A. C. Douglas (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Phys., 24: 614-19(1961). (In English)

Magnetic spectrograph data on levels in nuclei of mass 18 to 34 are discussed in relation to nuclear level densities and temperatures. It is pointed out that, contrary to the situation in nuclei with mass about 50, the level densities do not vary in a simple manner with the odd or even character of the nuclei. Some extensions of the magnetic spectrograph work are suggested. (auth)

24329 PROTONS AND DEUTERONS FROM Al^{27} BOMBARDED BY 14.8 MEV NEUTRONS. R. N. Glover and E. Weigold (Australian National Univ., Canberra). Nuclear Phys., 24: 630-41(1961). (In English)

Angular distributions for direct interaction proton groups corresponding to individual Mg^{27} levels are measured and shown to agree with theoretical predictions. Nuclear temperatures of 1.55 ± 0.15 Mev and 0.49 ± 0.02 Mev are found for the reactions $(n,p\gamma) + (n,pn)$ and (n,np), respectively. Cross sections for proton emission are: total 273 ± 20 mb; $(n,p\gamma) + (n,pn)$ 89 mb compound nucleus, 27 mb direct interaction; (n,np) 157 mb. Spins are assigned to several Mg^{27} levels from analysis of the present experiment and of previous $Mg^{26}(d,p)Mg^{27}$ experiments. Angular distributions of deuteron groups corresponding to Mg^{26} levels at 0, 1.83, and 3.6 Mev are measured. Reduced widths are extracted and shown to agree with the predictions of the rotational model. (auth)

24330 MECHANISM OF INTERACTION OF FAST NUCLEONS WITH NUCLEI. V. A. Barashenkov, V. M. Maltsev, and E. K. Mikhul (Joint Inst. for Nuclear Research, Dubna, USSR). Nuclear Phys., 24: 642-56(1961). (In English)

Results are presented from calculations of intranuclear cascades generated by a 9 Bev proton in photoemulsion nuclei. From comparing these results with the available experimental data it follows that an intranuclear cascade mechanism is operating in nucleon-nucleus collisions at E = 9 Bev just as at lower energies. What the nucleon-nucleus interaction mechanism is like at very high energies ($E \gg 10$ Bev)—whether it is a nucleon-tube mechanism or an intranuclear cascade mechanism—is still an open question. (auth)

24331 RESONANCES IN THE $K^{39}(p,\gamma)Ca^{40}$ REACTION FROM 1.0 TO 2.1 MEV. R. A. Pope, D. V. Freck, and W. W. Evans (Associated Electrical Industries, Aldermaston, Berks, Eng.). Nuclear Phys., 24: 657-65(1961). (In English)

Resonances were found at $E_p = 1133.0 \pm 1.4$, 1311.7 ± 1.6, 1349.3 ± 1.6, 1579.9 ± 1.9, 1769.7 ± 2.1, and 2046.7 ± 2.5 kev, half-widths all being less than 0.5 kev. A number of closely-spaced resonances in the region of $E_p = 1880$ kev

were also observed. The main features of decay at each resonance were investigated. (auth)

24332 SYSTEMATIC TRENDS IN HALF-LIVES OF BETA-DECAYING NUCLIDES. G. Andersson (Univ. of Uppsala). Nuclear Phys., 24: 666-74(1961). (In English)

Linear relationships between log $T_{\frac{1}{2}}$ and A are shown to exist among neutron deficient Pb and Tl nucleides, if odd and even mass numbers are taken separately and $T_{\frac{1}{2}}$ is the pure beta half life. The same simple systematics is found to apply to numerous other series of alternate isotopes, neutron rich as well as neutron deficient, indicating its usefulness in predicting half lives. Attempts to establish the conditions for occurrence of these regularities meet with difficulties due to a lack of experimental data. The probable spin and parity dependence of the systematics may enable level assignments in certain cases of isomerism. (auth)

24333 γ-RAYS FROM THE 1.14 MEV RESONANCE IN $B^{10}(p,\gamma)C^{11}$. A. N. James (Cavendish Lab., Cambridge, Eng.). Nuclear Phys., 24: 675-81(1961). (In English)

Gamma rays from the 1.14 Mev resonance in $B^{10}(p,\gamma)C^{11}$ were observed using a 15.2 cm long by 10.2 cm diameter NaI(Tl) scintillation spectrometer. As well as the ground state γ-rays, cascades through the 4.32 and 6.48 Mev states were observed, the 6.48 Mev state decaying partly by a cascade through the 4.32 Mev level. A spin of $\frac{5}{2}-$ is proposed for the 9.74 Mev level in C^{11}. (auth)

24334 COLLECTIVE EXCITATIONS CORRESPONDING TO QUADRUPOLE NUCLEAR SURFACE VIBRATIONS. A. S. Davydov (Moscow State Univ.). Nuclear Phys., 24: 682-94(1961). (In English)

The solutions of the set of equations for the rotation-vibrational spectrum of non-spherical nuclei are investigated, γ vibrations being taken into account in the equations. It is shown that zero spin excited states can refer to β vibrations as well as to γ vibrations. (auth)

24335 SEMIEMPIRICAL ATOMIC MASS LAW. Philip A. Seeger (California Inst. of Tech., Pasadena and Los Alamos Scientific Lab., N. Mex.). Nuclear Phys., 25: 1-135(1961). (In English)

New terms for the atomic mass law are proposed, which incorporate effects of nuclear deformation and shell structure such as interference effects between unfilled neutron and proton shells. In addition, a surface-symmetry term is included. Coulomb terms use radii determined by electron scattering. The standard deviation of calculated masses is reduced by the addition of these terms, as is the error in extrapolating from one side of the valley of beta stability to the other. The usefulness of the law for calculating the mass and binding energy of atoms with large neutron excess is discussed. A table giving mass excess; neutron, proton, and alpha-particle binding energies; and beta decay transition energies is appended. (auth)

24336 THE ANGULAR CORRELATION OF PROMPT NEUTRONS AND FISSION FRAGMENTS IN THERMAL NEUTRON FISSION OF U^{235}. R. Ramanna, R. Chaudhry, S. S. Kapoor, K. Mikke, S. R. S. Murthy, and P. N. Rama Rao (Atomic Energy Establishment, Trombay, India). Nuclear Phys., 25: 136-51(1961). (In English)

The angular distributions of the prompt neutrons of specified mean energies emitted in the thermal neutron fission of U^{235} are measured with respect to the direction of motion of light fragments. A combination of a gridded ionization chamber and a gas scintillation counter system using xenon gas is used to measure the energy of the fission fragments as well as their direction of motion relative to the electric field direction of the ionization chamber. A fast neutron detector is placed along the electric field direction to measure the energy of the prompt neutrons by time of flight technique. The distributions obtained are compared with the distributions computed on the assumption of isotropic emission of neutrons with a Maxwellian emission spectrum. It is shown that the laboratory anisotropy $N(0°)/N(90°)$ is an increasing function of the neutron energy in the laboratory system. The laboratory angular distributions are transformed to obtain the center-of-mass angular distributions for two groups of prompt neutron emission energies. Anisotropy of the form $(a + b\cos^2\theta)$ is indicated for prompt neutrons with emission energies greater than 1 Mev. Anisotropy of emission is discussed in terms of the possibility of the fragments acquiring a large angular momentum at the instant of scission. (auth)

24337 SHELL MODEL THEORY OF Pb^{205}. William W. True (Princeton Univ., N. J.). Nuclear Phys., 25: 155-68 (1961). (PUC-1960-11) (In English)

The energy eigenvalues and eigenfunctions are calculated for the lower levels of Pb^{205} for a pure singlet-even two-body force between nucleons, and for a singlet-even force plus weak coupling of the particle motion to the quadrupole collective motion of the core. Better agreement with experiment is found when weak coupling of the core is included. More experimental data are needed before a complete decay scheme for Pb^{205} can be determined. (auth)

24338 NOTE ON THE TWO-NUCLEON STRIPPING PROCESS. M. L. Rustgi (National Research Council, Ottawa). Nuclear Phys., 25: 169-74(1961). (In English)

An expression is derived for the angular distribution of a process $N(He^3,p)Npn$ (bound) in which the stripped proton, by flipping its spin, imparts an extra unit of angular momentum to the bound Npn system. No comparison with experiment is made because of the unavailability of experimental data for such a process. An expression for the differential cross section of a similar process, in which two nucleons are captured from an incident He^3 or similar nucleus, is derived in the zero-range approximation and compared with theoretical results. (auth)

24339 BETA DECAY OF Tm^{171}. B. L. Sharma (Defence Science Lab., Delhi). Nuclear Phys., 25: 175-6 (1961). (In English)

Er_2O_3 enriched in the isotope Er^{170} was exposed to a thermal neutron flux of 10^{12} $cm^{-2} \cdot sec^{-1}$. In order to study the beta decay of 1.9 year Tm^{171}, the Er fraction showing strong 7.5 hr Er^{171} activity, which was obtained by ion exchange column separation of $Er^{170} + n$, was allowed to decay for a considerable time. Well crystal measurements were then made. Apart from Yb K x-rays and their escape peaks, the measurements showed the presence of a highly internally converted photo-peak at 67 kev. The proposed decay scheme of Tm^{171}, together with the spin assignments of various states, were discussed. (auth)

24340 U^{238} RADIATIVE CAPTURE IN PWR-2 BLANKET GEOMETRY. W. Baer (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 10: 235-9(July 1961).

Measurements of ρ^{28}, the ratio of epithermal to thermal neutron radiative capture in U^{238}, was carried out in the plate fuel geometry planned for the second Shippingport Pressurized Water Reactor (PWR-2). The experimental results are compared with two-dimensional diffusion theory analyses, and the agreement is considered satisfactory. (auth)

24341 THE FORMATION OF Cd^{115m} OR Cd^{115g} IN THE REACTION $U(\alpha,f)X$. H. Münzel (Kernforschungszentrum,

Karlsruhe, Ger.). Nukleonik, 3: 58-61(May 1961). (In German)

The fragment yields σ of Cd^{115g} and Cd^{115m} and the cumulative yield of Ag^{115g} in the reaction U(α,f)X were determined for α energies from 25 to 45 Mev. For the ratio $\sigma Cd^{115m}/\sigma Cd^{115g}$ a minimum was obtained for a projectile energy of about 30 Mev. By calculation it was shown that this minimum was not produced by the Cd^{115g} formed directly from Ag^{115m}, for which a correction was not possible. (tr-auth)

24342 ON THE DECAY SCHEME OF ^{128}Cs. S. Jha, R. K. Gupta, H. G. Devare, G. C. Pramila, and K. P. Gopinathan (Tata Inst. of Fundamental Research, Bombay). Nuovo cimento (10), 20: 76-86(Apr. 1, 1961). (In English)

The results of β spectrometer and scintillation spectrometer studies of 2.5 min Cs^{128} decay are presented. The Fermi plot of the positron spectrum gives the following end-point energies (intensities are in parentheses): (2885 ± 25) kev (100, log ft = 4.8), (2445 ± 25) kev (39, log ft = 5.1), (1900 ± 40) kev (≤16, log ft ≥ 5.1), and (1300 ± 40) kev (≤8, log ft ≥ 4.6). The analysis of the γ spectra in scintillation spectrometers shows the following γ rays: 168 kev (10), 270 kev (23), 440 kev (50), 511 kev (200), 970 kev (1.5), 1120 kev (2.1), 1660 kev (0.4), 2180 kev (0.36), and 2420 kev (0.2). With these data, β^+-γ and γ-γ coincidence studies, the following levels in Xe^{128} are suggested: ground state (0^+), 440 kev (2^+), 970 kev (2^+), 1560 kev (0^+ or 2^+) (all fed by positrons and electron captures); and 2620 kev (perhaps 3^-) and 2860 kev (2^+) fed by electron captures only. The 2620 kev state may be the first octupole vibrational level. (auth)

24343 THE PICK-UP REACTION ON THE NUCLIDES ^{45}Sc, ^{51}V, ^{52}Cr, ^{54}Fe, ^{56}Fe, ^{55}Mn, ^{59}Co, ^{58}Ni, ^{60}Ni. L. Colli (Università, Milan), I. Iori, S. Micheletti, and M. Pignanelli. Nuovo cimento (10), 20: 94-103(Apr. 1, 1961). (In English)

Energy spectra of deuterons from (n, d) reaction on elements belonging to the $f_{7/2}$ proton shell (Sc^{45}, V^{51}, Cr^{52}, Fe^{54}, Fe^{56}, Mn^{55}, Co^{59}, Ni^{58}, and Ni^{60}) are presented. Deuteron peaks corresponding to the fundamental and some excited levels of the residual nucleus are shown. A comparison is made between relative experimental intensities of ground state transitions, and those predicted on the basis of the shell model hypothesis and the Butler's pick-up mechanism for the (n, d) reaction. (auth)

24344 $\beta^+ \rightarrow \gamma$ ANGULAR CORRELATION IN THE DECAY OF ^{22}Na. B. N. Subba Rao (Tata Inst. of Fundamental Research, Bombay). Nuovo cimento (10), 20: 178-81 (Apr. 1, 1961). (In English)

The β^+–γ angular correlations in the β^+ decay of Na^{22} are studied, in an attempt to detect any second forbidden matrix element contributions to the allowed β^+ decay amplitude. The integral directional correlation is measured for β^+ energies above 120 kev, and the anisotropy is measured as a function of β^+ energy from 100 to 600 kev. It is found that the angular correlations cannot be explained on the basis of forbidden contributions. (T.F.H.)

24345 INVESTIGATION OF THE MECHANISM OF HIGH ENERGY NUCLEON-NUCLEUS INTERACTION. G. Bozóki, E. Fenyves, E. Gombosi, and P. Surányi (Central Research Inst. of Physics, Budapest). Nuovo cimento (10), 20: 429-37(May 1, 1961). (In English)

Nuclear interactions of 9 Bev protons with emulsion nuclei were investigated. A composite nuclear interaction model was induced from the individual events, and the angular and energy distribution of identified shower particles were measured. From these data the mean value of the inelasticity coefficient and the mean number of nucleons struck in a proton-nucleus collision were calculated for an "average" emulsion nucleus. It was shown by comparing the results with those found for nucleon-nucleon collision at 6.2 Bev that the nucleon-nucleus interaction is better described at these energies by the cascade model than by the tunnel model. From this result the mean life of the excited state of a colliding nucleon-nucleon system was estimated to be less than $3 \cdot 10^{-23}$ sec. (auth)

24346 BRANCHING RATIO OF γ AND β EMISSIONS FROM ^{212}Bi(ThC). S. Barkan (Argonne National Lab., Ill.). Nuovo cimento (10), 20: 450-3(May 1, 1961). (In English)

Semiconductor counters, which have good efficiency and energy resolution, were used to measure the Bi^{212} branching ratio. The measurement was made by comparison of the intensity of the low-energy (<7 Mev) Bi^{212} alphas with that of the high-energy (<7 Mev) alphas coming from Po^{212} produced by β-decay of Bi^{212}. The average of 8 runs gave $\alpha/(\alpha + \beta) = 0.358 \pm 0.001$. (auth)

24347 EFFECT OF INELASTIC SCATTERING ON POLARIZATION ASYMMETRY. G. Felsner and M. E. Rose (Oak Ridge National Lab., Tenn.). Nuovo cimento (10), 20: 509-18(May 1, 1961). (In English)

The inelastic scattering of polarized relativistic electrons by atoms is calculated using modified first Born approximation. In order to evaluate the matrix elements the Thomas-Fermi model of the atom is used. In the case of gold the asymmetry from the inelastic scattering makes a negligible change in the asymmetry from the total (inelastic plus Mott) scattering. (auth)

24348 EVIDENCE FOR PION-PION INTERACTIONS FROM S-WAVE PION-NUCLEON SCATTERING. J. Hamilton, P. Menotti, T. D. Spearman, and W. S. Woolcock (University Coll., London). Nuovo cimento (10), 20: 519-28 (May 1, 1961). (In English)

By fitting the s-wave partial amplitudes for π-N scattering in an unphysical region, the energy range is greatly extended over which the contribution from the process $\pi + \pi \rightarrow N + \bar{N}$ may be examined. The method detects contributions from this process in states of isotopic spin T = 0 and T = 1. The energies $t^{1/2}$ are estimated for which this process is important. The form of these contributions is as expected from considerations of angular momenta. Estimates of the amplitudes for $\pi + \pi \rightarrow N + \bar{N}$ are deduced. The T = 0 amplitude is large, but in the T = 1 case the amplitude is much smaller than the values predicted from the nucleon isovector form factors. (auth)

24349 MUONIUM-ANTIMUONIUM TRANSITIONS. S. L. Glashow (California Inst. of Tech., Pasadena). Nuovo cimento (10), 20: 591-2(May 1, 1961). (In English)

A quantum number m is proposed for leptons, such that $m(\mu^+) = -m(e^+) = \pm 1$. In this system, μ decay may have $\Delta m = 0$, 2, or 4, depending on the m assignments to the neutrinos. Processes such as $\mu \rightarrow e + \gamma$ violate $\Delta m = 2$; and if no processes can be found with $\Delta m = 4$, m may be assumed to be a good quantum number. The muonium-antimuonium transition, if it exists, has $\Delta m = 4$; the problems associated with detecting these transitions are described. (T.F.H.)

24350 A NOTE ON PRODUCTION DISPERSION RELATION. A. Minguzzi (CERN, Geneva). Nuovo cimento (10), 20: 599-600(May 1, 1961). (In English)

The dispersion relations for the production reaction A + B → C + D are studied. A preliminary examination suggests that the absorptive part of the scattering amplitude should be non-analytic in a region S, because of the differing

thresholds for the A + B → A + B and C + D → C + D reactions. It is found, however, from a consideration of rotational invariance, that no region S exists. (T.F.H.)

24351 THREE-BODY FINAL STATES FROM K^- CAPTURE IN HELIUM AND DEUTERIUM. M. M. Block (Duke Univ., Durham, N. C.). Nuovo cimento (10), 20: 715-23(May 16, 1961). (In English)

Impulse-model calculations were made for interactions at rest of K^- mesons in He^4 and D. With the assumptions of noninteracting emergent particles, momentum spectra were calculated for the reactions: $K^- + He^4 \rightarrow \Lambda^0 + \pi^- + He^3 \rightarrow \Sigma^+ + \pi^+ + He^3$ and $K^- + D \rightarrow \Lambda^0 + \pi^- + p \rightarrow \Sigma^+ + \pi^+ + n$. (auth)

24352 MAGNETIC SHIELDING OF A NUCLEUS BY FREE ELECTRONS. Michael J. Stephen (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 123: 126-30(July 1, 1961).

The magnetic shielding constant of a nucleus by free electrons is evaluated, by obtaining the classical partition function for a system of free electrons in a uniform magnetic field perturbed by the field of a nuclear magnet. Both diamagnetic and paramagnetic terms are included in the Hamiltonian. For a highly degenerate gas, the shielding constant has oscillatory terms similar to those in the magnetic susceptibility of a free-electron gas. The possibility of observing these terms is discussed. (auth)

24353 LOW-ENERGY ELECTRON SCATTERING FROM ATOMIC OXYGEN. R. H. Neynaber, Lawrence L. Marino, Erhard W. Rothe, and S. M. Trujillo (Convair, San Diego, Calif.). Phys. Rev., 123: 148-52(July 1, 1961).

The total cross section for the scattering of electrons by atomic oxygen is measured as a function of electron energy from 2.3 to 11.6 ev. The number of electrons scattered from a region defined by the intersection of an electron beam and a modulated molecular oxygen beam is compared with the number scattered when the oxygen beam is partially dissociated. A radio-frequency discharge dissociates about 30% of the molecules. The degree of dissociation is measured with a mass spectrometer. From the data, the ratios of atomic to molecular scattering cross sections are obtained. The absolute atomic values are calculated by multiplying these ratios by the molecular oxygen cross sections. The result is a virtually constant cross section of $(6.2 \pm 0.5)\pi a_0^2$ in the entire energy range studied. This result is compared with theoretical estimates. (auth)

24354 EFFECT OF VIRTUAL EXCITATIONS ON THE ELASTIC SCATTERING OF ELECTRONS AND POSITRONS BY ATOMIC HYDROGEN. Kenneth Smith (Argonne National Lab., Ill.) and P. G. Burke. Phys. Rev., 123: 174-8(July 1, 1961).

Total elastic cross sections for the scattering of electrons and positrons (neglecting positronium formation) from the 1s state of atomic hydrogen are calculated, allowing for virtual excitation to the 2s and 3s states. The S-, P-, and D-wave contributions to Q_{1s-1s} are computed for incident energies below 10 ev. The results for positron scattering show that virtual excitation to the 2s and 3s states only slightly affects the phase shifts calculated in the static approximation. The influence of the 2s state appears to be much more important for electrons. The scattering lengths are calculated. (auth)

24355 HYPERFINE STRUCTURE OF THE 24-KEV TRANSITION IN Sn^{119}. O. C. Kistner, A. W. Sunyar, and J. B. Swan (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 123: 179-83(July 1, 1961). (BNL-5292)

The Zeeman splittings of the ground state and 24 kev levels of Sn^{119} were measured by the method of recoilless emission and resonant absorption of the 24 kev γ radiation emitted in the decay of Sn^{119m}. The source consisted of Sn^{119m} diffused into a 0.002-in. iron foil. Grey tin metal at a temperature of ~10°C was used as the absorber. The magnitude of the internal magnetic field at the source nuclei was sufficient to allow resolution of the six absorption peaks resulting from the $\frac{3}{2}^+ \rightarrow \frac{1}{2}^+$ M1 transition. Measurements were made with the internal fields aligned by application of a small external magnetic field; in this manner the central line of each triplet could be enhanced or suppressed by observing the radiation emitted either perpendicular or parallel to the external field. The splitting parameters obtained from the measurements yielded a value of 0.672 ± 0.025 nm for the magnetic moment of the first excited state of Sn^{119}, and an effective magnetic field at the tin nuclei in the iron environment of 78.5 ± 2.0 kgauss. The chemical shift was such that the transition energy in the source was less than that in the absorber by $(4.24 \pm 0.04) \times 10^{-8}$ ev. Within the limits of measurement, no quadrupole coupling was observed. (auth)

24356 NEW YTTRIUM ISOMERS OF MASSES 86 AND 90. Larry Haskin (Univ. of Wisconsin, Madison, and Argonne National Lab., Ill.) and Robert Vandenbosch. Phys. Rev., 123: 184-5(July 1, 1961).

Cyclotron bombardment of Rb with alpha particles and Sr with deuterons yield two new yttrium activities. Y^{86m} decays with a half life of 49.0 ± 1.5 min. The isomer is supported by a highly converted 7.2 kev isomeric transition followed by a 210 kev gamma ray having a conversion coefficient $e/\gamma = 0.06 \pm 0.01$. Y^{90m} has a half life of 3.19 ± 0.06 hr, decaying to the Y^{90} ground state with emission of two gamma rays: 476 kev, $e/\gamma = 0.10 \pm 0.02$; and 203 kev, $e/\gamma = 0.036 \pm 0.007$. Spin and parity assignments are made for the Y^{90} levels. (auth)

24357 NUCLEAR ORIENTATION OF Dy^{155} AND Dy^{157}. Quirino O. Navarro and D. A. Shirley (Univ. of California, Berkeley). Phys. Rev., 123: 186-9(July 1, 1961).

The isotopes Dy^{155} and Dy^{157} were aligned at low temperatures in a single crystal of neodymium ethylsulfate, using the magnetic hfs method. Angular distribution of gamma radiation following the decay of these isotopes was studied as a function of temperature in the region 0.02 to 1°K. Spin assignments of $\frac{5}{2}-$ were made to states at 227 kev in Tb^{155} and at 327 kev in Tb^{157}. Assuming $I = \frac{3}{2}$ for both Dy isotopes as well as pure L = 1 beta decay to the $\frac{5}{2}-$ states, nuclear moments of $|\mu_{155}| = 0.21 \pm 0.05$ nm and $|\mu_{157}| = 0.32 \pm 0.02$ nm were derived. (auth)

24358 POSITRON SPECTRA OF Co^{56}. J. H. Hamilton (Vanderbilt Univ., Nashville) and L. M. Langer and D. R. Smith. Phys. Rev., 123: 189-93(July 1, 1961).

The positron spectrum of Co^{56} is carefully studied with a magnetic spectrometer. Two positron groups are observed. The maximum energies and intensities of the two groups are 1.464 ± 0.015 and 0.440 ± 0.030 Mev, and ≥90 and ≤10% respectively. No evidence for any other groups is found. In particular, an upper limit of 1% is set for any group with maximum energy 0.9 to 1.0 Mev. The high-energy spectrum has essentially an allowed shape. However, the inclusion of a shape factor such as (1 + 0.3/W) offers a more consistent fit to all the data. (auth)

24359 9.17-MEV STATE IN N^{14}. R. E. Segel, J. W. Daughtry, and J. W. Olness (Aeronautical Research Lab., Dayton, Ohio). Phys. Rev., 123: 194-6(July 1, 1961).

The angular distributions of the 9.17 Mev ground state gamma ray and the gamma rays of the 2.73-6.44 Mev cascade resulting from the 1.75 Mev proton resonance on

$C^{13}(N^{14*} = 9.17$ Mev) are measured. Spins are deduced from the angular distributions, for the 9.17 and 6.44 Mev states. The angular momenta admixtures required are found to be in disagreement with one of the shell models of N^{14}, but it is shown that the model can be brought into accord with experiment by having the 9.17 Mev state wave function include a configuration with a nucleon in the f shell. (auth)

24360 In^{116} ACTIVATION RATIOS. M. A. Greenfield (Univ. of California, Los Angeles) and R. L. Koontz. Phys. Rev., 123: 197-8(July 1, 1961).

Data regarding the ratio of the 54 min to the 13 sec activities of In^{116} produced by neutron capture in In^{115} are corrected with experimentally determined self-absorption factors for 54 min In^{116}. The results of these corrections remove an anomaly observed between foils of different thicknesses, provided the foil is uniformly activated throughout its volume. The corrections appear to remove a dependence of the ratio of activities on neutron energies from thermal to 2.66 ev. The corrected value of the ratio at 3.86 ev, however, is about one half the value at the lower energies investigated. (auth)

24361 HYPERFINE STRUCTURE OF THE $(5p)^5(6s)^3P_2$ STATE OF $_{54}Xe^{129}$ AND $_{54}Xe^{131}$. W. L. Faust and M. N. McDermott (Columbia Univ., New York). Phys. Rev., 123: 198-204(July 1, 1961).

The hyperfine structures of the metastable $(5p)^5(6s)^3P_2$ state of Xe^{129} and Xe^{131} are measured by the atomic beam magnetic resonance method. The zero magnetic field intervals $f(F \simeq F')$ are: for Xe^{129}, $f(\frac{3}{2} \simeq \frac{5}{2}) = 5961.2577(9)$ Mc; and for Xe^{131}, $f(\frac{5}{2} \simeq \frac{7}{2}) = 2693.6234(7)$ Mc, $f(\frac{3}{2} \simeq \frac{5}{2}) = 1608.3475(8)$ Mc, and $f(\frac{1}{2} \simeq \frac{3}{2}) = 838.7636(4)$ Mc. The values of the quadrupole and octupole moments of Xe^{131}, without polarization corrections and without corrections for any effects of configuration mixing, are $Q = -0.120(12)$ b and $\Omega = +0.048(12)$ b.nm. The hyperfine-structure anomaly for the two isotopes due to the $s_{\frac{1}{2}}$ electron alone is $\Delta(s_{\frac{1}{2}}) = +0.0440(44)\%$, in disagreement with the prediction of the single-particle model. (auth)

24362 HALF-LIFE OF SAMARIUM-147. P. M. Wright, E. P. Steinberg, and L. E. Glendenin (Argonne National Lab., Ill.). Phys. Rev., 123: 205-8(July 1, 1961).

A liquid scintillation counting technique is applied to the determination of the half life of Sm^{147} by specific alpha activity measurement. A value of $(1.05 \pm 0.02) \times 10^{11}$ years is obtained. (auth)

24363 NEUTRON TOTAL CROSS SECTIONS OF Be, B^{10}, B, C, AND O. D. B. Fossan, R. L. Walter, W. E. Wilson, and H. H. Barschall (Univ. of Wisconsin, Madison). Phys. Rev., 123: 209-18(July 1, 1961).

Total cross sections of Be, B^{10}, B, C, and O are measured for neutrons of energies between 3.4 and 16 Mev. Neutrons of energy spreads between 15 and 40 kev are produced by bombarding tritium targets with protons or deuterium targets with deuterons, the charged particles being accelerated in a tandem electrostatic accelerator. Sharp peaks in the total cross sections of B^{11}, C, and O yield information about energy levels in B^{12}, C^{13}, and O^{17}. None of the total cross sections of the five nuclei investigated show sharp peaks above energies corresponding to an excitation energy of the order of 12 Mev of the respective compound nucleus. The transition from sharp structure to a slowly varying cross section occurs quite abruptly, except for the compound nucleus B^{11} which is excited to almost 12 Mev even for slow neutrons. (auth)

24364 DEUTERIUM AND BERYLLIUM (n,2n) CROSS SECTIONS BETWEEN 6 AND 10 MEV. H. C. Catron, M. D. Goldberg, R. W. Hill, J. M. LeBlanc, J. P. Stoering, C. J. Taylor, and M. A. Williamson (Univ. of California, Livermore). Phys. Rev., 123: 218-20(July 1, 1961). (UCRL-6141-T)

The (n,2n) cross sections of deuterium and beryllium are measured for incident neutron energies from 6 to 10 Mev using a large liquid scintillator. The cross sections in barns obtained for deuterium are 0.067 ± 0.007 at 6.11 Mev, 0.073 ± 0.007 at 6.55 Mev, 0.088 ± 0.009 at 7.32 Mev, 0.11 ± 0.010 at 8.26 Mev, and 0.14 ± 0.015 at 10.2 Mev. The beryllium cross sections are 0.55 ± 0.08 at 6.55 Mev, 0.56 ± 0.07 at 7.32 Mev, and 0.63 ± 0.09 at 8.26 Mev. (auth)

24365 NUCLEAR ENERGY LEVELS OF F^{19}, F^{21}, Ne^{22}, AND Ne^{24}. M. G. Silbert and Nelson Jarmie (Los Alamos Scientific Lab., Los Alamos). Phys. Rev., 123: 221-8 (July 1, 1961).

A 180° double-focusing magnetic spectrometer was used to investigate the nuclear energy levels of F^{19}, F^{21}, Ne^{22}, and Ne^{24} by analysis of protons and alpha particles produced by (t,p) and (t,α) reactions with natural neon and with Ne^{22} gas targets. Between excitation energies of 2.8 and 6.5 Mev, new levels in F^{19} were found at 5.102, 5.539, 5.628, 5.937, and 6.169 Mev. Previously reported levels at 3.29, 4.48, and 4.95 Mev were not observed. Up to an excitation energy of 4.3 Mev in F^{21}, new levels were seen at 3.451, 3.509, 3.635, 3.977, 4.056, and 4.158 Mev, and the four known lower states at 0.285, 1.104, 1.743, and 2.047 Mev were confirmed. The mass M of F^{21} was determined to be 21.006624 ± 0.000011 amu (O^{16} standard); $(M-A) = 6.168 \pm 0.010$ Mev. In Ne^{22} 38 excited states were observed up to an excitation of 9.4 Mev. Levels at 1.277, 3.343, and 4.473 Mev were confirmed, while a reported level at 4.9 Mev was not observed. Energy levels in Ne^{24}, up to an excitation energy of 6.4 Mev, were found at 1.986, 3.873, 3.962, 4.764, 4.886, 5.576, (5.641), and 6.030 Mev. The mass of Ne^{24} was determined to be 24.001238 ± 0.000011 amu (O^{16} standard); $(M-A) = 1.153 \pm 0.010$ Mev. Standard deviations in the values for the excitation energies vary from 0.015 to 0.025 Mev. Some representative cross sections are reported. (auth)

24366 PHOTODISINTEGRATION OF Be^9 FROM THRESHOLD TO 5 MEV. Mark J. Jakobson (Montana State Univ., Missoula). Phys. Rev., 123: 229-30(July 1, 1961).

A bremsstrahlung-photon difference method measurement of the $Be^9(\gamma,n)$ cross section indicates maxima in the cross section of 1.15 ± 0.15, 0.55 ± 0.1, 1.2 ± 0.2, and 1.0 ± 0.3 mb at energies of 1.70, 2.40, 2.95, and 4.6 Mev, respectively. The angular distribution of the neutrons corresponding to the 1.70 and 4.6 Mev peaks is spherically symmetric; $d\sigma/d\Omega = a + b \sin^2\theta (a/b = 1.0 \pm 0.2)$ for the 2.95 Mev peak. (auth)

24367 REACTIONS OF ALPHA PARTICLES WITH IRON-54 AND NICKEL-58. Frank S. Houck and J. M. Miller (Columbia Univ., New York and Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 123: 231-40(July 1, 1961). (BNL-5266)

The excitation functions for the (α,p), (α,n), (α,pn), $(\alpha,2n)$, $(\alpha,2pn)$, and $(\alpha,p2n)$ reactions of Fe^{54} and the $(\alpha,\alpha'p)$, $(\alpha,\alpha'n)$, $(\alpha,\alpha'pn)$, and $(\alpha,\alpha'2n)$ reactions of Ni^{58} are determined for alpha energies up to 40 Mev. A large preference for proton emission is observed. At the maxima in the excitation functions, these ratios were obtained: $\sigma(\alpha,p)/\sigma(\alpha,n) = 3.1$; $\sigma(\alpha,pn)/\sigma(\alpha,2n) = 70$; $\sigma(\alpha,\alpha'p)/\sigma(\alpha,\alpha'n) = 6$; $\sigma(\alpha,2pn)/\sigma(\alpha,p2n) = 6.3$ (at 40 Mev); and $\sigma(\alpha,\alpha'pn)/\sigma(\alpha,\alpha'2n) = 140$ (at 40 Mev). These results are discussed in terms of the compound-nucleus model. A value of $r_0 = 1.7$ fermis is required to fit the low-energy portion of the observed "total"

cross section with total reaction cross section calculated from continuum theory. (auth)

24368 TWICE FORBIDDEN BETA-RAY TRANSITION OF Co^{60}. D. C. Camp, L. M. Langer, and D. R. Smith (Indiana Univ., Bloomington). Phys. Rev., 123: 241(July 1, 1961).

The high-energy beta transition from the ground state of Co^{60} to the first excited state of Ni^{60} is studied in a magnetic spectrometer. The shape of the beta spectrum is found to be consistent with that expected for a "unique" twice forbidden transition from a 5+ to a 2+ level. The relative intensity of this 1.48 Mev transition is found to be 0.12%. The comparative half life is $\log(\langle S_2^3 \rangle f_0 t) = 11.8$, in close agreement with the values found for other "unique" twice forbidden transitions of Be^{10} and Na^{22}. (auth)

24369 EVIDENCE FOR SEQUENTIAL TWO-BODY DECAY IN THREE-BODY DECAY OF C^{12} AND B^{10}. E. H. Beckner, C. M. Jones and G. C. Phillips (Rice Univ., Houston, Tex.). Phys. Rev., 123: 255-61(July 1, 1961).

The reactions $B^{11}(p,\alpha)Be^8$ and $Be^9(p,d)Be^8$ are studied employing monoenergetic protons, thin targets, and a low-background magnetic spectrometer to resolve the disintegration products. The continuum spectra of alpha and deuteron particles produced in the reactions are compared to the generalized density-of-states function, and fits are obtained. The density function is calculated from the experimental (α,α) scattering phase shifts. The calculated S-wave density function for Be^8 predicts a low-energy anomaly. This anomaly is observed and confirms the assumption of the model used to calculate this spectral shape, i.e., three-body decay proceeding via a sequence of two-body decay modes. (auth)

24370 NUCLEAR ELECTRIC MONOPOLE TRANSITION IN Ca^{42}. N. Benczer-Koller, M. Nessin, and T. H. Kruse (Columbia Univ., New York). Phys. Rev., 123: 262-5 (July 1, 1961).

The 0^+ assignment to the 1.836 Mev second excited state in Ca^{42} is confirmed, by the observation of electric monopole electron-positron pairs and internal conversion electrons corresponding to the crossover transition to the ground state. The shape of the continuous positron spectrum from the E0 pairs, as well as the ratio $R = 9.0 \pm 1.8$ of pairs to E0 conversion electrons are consistent with theoretical predictions for an E0 transition. 0.305 Mev internal conversion electrons are observed corresponding to the transition between the 1.836 Mev and the 2^+, 1.523 Mev, first excited state. The ratio of 1.836 Mev to 0.305 Mev electron yields is 1.03 ± 0.10. From these and other data the monopole strength parameter is determined to be 0.41. (auth)

24371 COULOMB BARRIER IN A HIGHLY EXCITED NUCLEUS. D. W. Lang (Australian National Univ., Canberra). Phys. Rev., 123: 265-6(July 1, 1961).

Experiments involving alpha emission spectra from nickel and rhodium bombarded with protons are analyzed using the statistical model. It is shown, using values calculated for the cross sections for alpha absorption, that the experimental data are consistent with a constant value for the potential barrier. (auth)

24372 EFFECT OF COMPETITION BETWEEN GAMMA-RAY AND PARTICLE EMISSION ON EXCITATION FUNCTIONS. James Robb Grover (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 123: 267-75(July 1, 1961). (BNL-5267)

A procedure is devised for calculating cross sections for nuclear reactions within about 2 Mev of threshold, where competition between gamma and particle emission is often important. The requisite formulas depend upon assumptions embodied in the spin-dependent statistical theory of nuclear reactions, so the treatment is most valid for medium to heavy nuclei at moderate bombarding energies. Data required by the formulas are the level density parameter a; an effective nuclear moment of inertia I; the ratio of radiation width to level spacing (Γ_γ/D) evaluated at some convenient energy, spin, and parity in the excited nucleus immediately preceding the product; transmission coefficients $T_l(\epsilon)$ for the range of energies and type of particle in the final evaporation step; and the energies, spins, and parities of the first few excited states in the product nucleus. Using reasonable estimates for I, Γ_γ/D, and $T_l(\epsilon)$, experimental excitation functions near threshold for the reactions $Bi^{209}(p,2n)Po^{208}$ and $Sm^{144}(\alpha,3n)Gd^{145}$ are analyzed to find the corresponding values of a. The results are consistent with $a \sim 0.1$ A Mev^{-1} (A is the mass number), but inconsistent with $a \sim 2$ to 3 Mev^{-1} (independent of A), in contrast to the result obtained when competition from gamma emission is ignored. Also, a semiqualitative argument is given to suggest that competitive gamma emission often seriously influences excitation functions even several Mev above threshold. (auth)

24373 INTERACTIONS OF 7.5-MEV PROTONS WITH COPPER AND VANADIUM. Bruce W. Shore, Nathan S. Wall, and John W. Irvine, Jr. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 123: 276-83(July 1, 1961).

The separate cross sections are measured for interactions of 7.5 Mev protons with natural copper and vanadium. Angular distributions for elastic scattering are presented. The (inelastic scattering + alpha emission) cross sections are for Cu, 266 mb, and 134 mb for V. The (p,n) reaction cross sections are 537 mb for Cu^{65}, and 555 mb for V^{51}. These data, along with separate measurements of polarization from copper, are compared with optical model computations. The results indicate a volume-absorption potential rather than a surface-absorption potential. (auth)

24374 SURVEY OF INELASTIC SCATTERING OF DEUTERONS BY HEAVY ELEMENTS. Bernard L. Cohen and Robert E. Price (Univ. of Pittsburgh). Phys. Rev., 123: 283-94(July 1, 1961).

Energy spectra of inelastically scattered deuterons from approximately 30 heavy elements are measured with about 80 kev resolution. Many levels are reported, including a level in Pr^{141} whose discovery substantially alters the decay scheme of Nd^{141}. The gross structure of the spectra is studied and several regularities are noted. Angular distributions in Zr and the even isotopes of Sn indicate that the parity of the strongest levels in the anomalous peaks (~2.5 Mev) are negative, in agreement with the assumption that they are the 3^- collective vibrational level; however, there are also several strongly excited positive-parity levels in that region. The correlation between cross sections for exciting given levels by (d,d') and (d,p) or (d,t) reactions is studied. The correlation coefficients are generally slightly negative, but there are several cases where the same levels are strongly excited by all three reactions, including one case (in Sn^{117}) where the principal $d_{\frac{3}{2}}$ single quasi-particle level is also the principal 2^+ vibrational level based on the $s_{\frac{1}{2}}$ ground state. A very strong positive correlation is found between cross sections for exciting given levels by Coulomb excitation and by direct-interaction inelastic scattering. The large peaks previously reported in inelastic deuteron scattering from Rh, Ag, and Sn at 4 to 5 Mev and from Ta and Pt at about 3 Mev are not found; explanations for this are offered. (auth)

24375 EVIDENCE FOR A π-π RESONANCE IN THE I = 1, J = 1 STATE. A. R. Erwin, R. March, W. D. Walker, and E. West (Brookhaven National Lab., Upton, N. Y. and Univ. of Wisconsin, Madison). Phys. Rev. Letters, 6: 628-30(June 1, 1961).

The reactions $\pi^- + p \rightarrow \pi^- + \pi^0 + p$, $\pi^- + p \rightarrow \pi^- + \pi^+ + n$, and $\pi^- + p \rightarrow \pi^0 + \pi^0 + n$ are studied at 1.89 Bev/c. Events with nucleon momentum transfer >400 Mev/c are excluded, in order to avoid interference from rescattering processes. The data indicate that an I = 1, J = 1 di-pion state exists at about 750 Mev. (T.F.H.)

24376 SPIN WAVES IN MnF_2 AND THE INELASTIC SCATTERING OF NEUTRONS. Ojiro Nagai (Osaka Univ.), and Akio Yoshimori. Progr. Theoret. Phys. (Kyoto), 25: 595-602(Apr. 1961).

The spin wave dispersion relation in the case of MnF_2 is studied for various assumed values of the ratio of the exchange coupling constants J_2 to J_1. The inelastic scattering cross section of neutrons by spin waves in this crystal is also calculated. Using the value of $J_2 = 1.08J_1$, which is supported experimentally, distinctive features of the scattering cross section are discussed. (auth)

24377 ANTISYMMETRIC TREATMENT OF DEUTERON-STRIPPING REACTION. STRIPPING AND HEAVY-PARTICLE-STRIPPING REACTIONS. Tsuyoshi Honda (Rikkyo Univ., Tokyo), and Haruo Ui. Progr. Theoret. Phys. (Kyoto), 25: 613-34(Apr. 1961).

The deuteron stripping reaction is formulated using completely antisymmetric wave functions. The amplitude of the reaction is represented as a sum of "ordinary" stripping and heavy-particle-stripping amplitudes. Analogous to the case of the ordinary stripping, the amplitude of the heavy-particle-stripping can be represented in terms of three reduced width amplitudes of bound nucleons, e.g. those of the captured neutron and proton in the residual nucleus and that of the emitted proton in the target nucleus, or alternatively, in terms of two reduced width amplitudes of the emitted proton and captured deuteron in bound states. This formalism enables calculations of both angular distributions and "magnitudes" of heavy-particle-stripping cross sections. For simplicity, the cutoff Born approximation is employed, though its generalization can be performed easily, as is discussed. (auth)

24378 DEUTERON STRIPPING AND HEAVY-PARTICLE-STRIPPING REACTIONS. Tsuyoshi Honda (Rikkyo Univ., Tokyo) and Harou Ui. Progr. Theoret. Phys. (Kyoto), 25: 635-45(Apr. 1961).

An antisymmetric formulation is applied to the analysis of experimental differential cross sections of (d,n) reactions. The dependences of the cross sections on the incident deuteron energies are compared with results in which the ratio (λ_1/λ_2) between the matrix element of the stripping and that of the heavy-particle-stripping reactions is taken to be an adjustable parameter. $B^{11}(d,n)C^{12}$, $Be^9(d,n)B^{10}$, and $C^{12}(d,n)N^{13}$ reactions are treated. Discussions are given concerning the dependence of the cross sections on the reaction Q-value, on the binding energy of the emitted nucleon in target nucleus, and on the orbital angular momentum of the captured deuteron. It is pointed out that energy dependences of (λ_1/λ_2) obtained phenomenologically are unreasonable. The experimental differential cross sections and their energy dependences can hardly be explained by stripping and heavy-particle-stripping mechanism, even if the cutoff Born approximation is adopted in the calculation of the cross sections. Calculations by means of the "distorted wave method" are suggested. (auth)

24379 KK$\pi\pi$-INTERACTION AND NUCLEON CORE. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 25: 646-52(Apr. 1961).

The contribution from the K meson cloud to s-wave pion-nucleon scattering is estimated under the assumption of the existence of a strong KK$\pi\pi$ interaction. A discussion of the effect of this interaction on high energy phenomena is made. (auth)

24380 ELASTIC SCATTERING OF FAST ELECTRONS BY THE HELIUM ATOM AND THE INTERELECTRONIC CORRELATION. Mitio Inokuti (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 25: 717-19(Apr. 1961).

The cross section for elastic scattering of electrons by He is calculated in the Born approximation, using accurate He ground state wave functions. Various types of wave functions are used to find the cross section at a scattering angle of 0°, where the effect of the ground state configuration on the cross section is greatest; the results are compared with experimental data. (T.F.H.)

24381 NUCLEON-NUCLEUS SCATTERING AND THE CHOICE BETWEEN SETS OF NUCLEON-NUCLEON PHASE SHIFTS. Alvin M. Saperstein (Univ. of Buffalo). Progr. Theoret. Phys. (Kyoto), 25: 716-17(Apr. 1961).

Nucleon-nucleon (N-N) phase shifts may be inferred from N-nucleus scattering polarization data. For trial sets of N-N phase shifts, the scattering polarization is calculated in the first Born approximation and compared with experimental data. It is shown that multiple scattering effects change the Born approximations. Choices between various sets of N-N phase shifts are thus rendered unreliable by these multiple scattering effects. (T.F.H.)

Particle Accelerators

24382 (BRL-Memo-1312) A METHOD FOR REDUCING ENERGY VARIATIONS OF A VAN DE GRAAFF ION BEAM. John D. Baldeschwieler and Thomas R. Jeter (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Nov. 1960. 22p. (AD-251959)

Signals from the slit control system and the terminal of a Van de Graaff accelerator were amplified and applied to the target in proper phase to reduce time dependent variations in beam energy. The $Al^{27}(p,\gamma)Si^{28}$ resonance at 0.992 Mev was used to measure the beam energy spread. The measurements indicate that further improvements in the beam energy distribution are possible with optimum voltage and phasing of the signal applied to the target. (auth)

24383 (CEA-1912) ANALYSIS OF FFAG ACCELERATORS AND THE EVOLUTION OF CIRCULAR ACCELERATORS. L. Jackson Laslett (Office of Naval Research, London and Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research). Mar. 22, 1961. 45p.

Conference held at Institut National des Sciences et Techniques Nucleaires, January 10, 1961.

A comparison of circular and linear accelerators is given and problems in acceleratory theory are discussed. The principle of the fixed-field alternating-gradient (FFAG) accelerators is outlined. The setting-up and interpretation of mean energy of focusing terms for a spiral FFAG synchrotron are discussed. The stable limiting amplitude near the nonlinear resonance $2Q_x = Q_r$ is given. The 40-Mev electron model of MURA is described. Linear and nonlinear methods of injection and extraction using a variable disturbance in the magnetic field are discussed along with collective effects. The interaction of the beam with the accelerating cavities and walls are treated. A modifica-

tion of the phase oscillation equation is given. The influence of the beams' high frequency fields on the Nielson longitudinal instability is discussed. (D.L.C.)

24384 (CERN-61-12) LENTILLES QUADRUPOLAIRES MAGNETIQUES CONSTITUANT LE DISPOSITIF DE FOCALISATION DU FAISCEAU DE MESONS μ DU CERN. (Magnetic Quadrupole Lens Component Arrangement in Focusing and Bunching μ Mesons at CERN). E. Brauner-sreuther, V. Chabaud, C. Delorme, and M. Morpurgo (European Organization for Nuclear Research, Geneva). Apr. 11, 1961. 70p.

The floating wire method is used for the direct determination of the elements of the linear transformation of a μ meson beam and the limits of the beam to which the transformation is applied. The floating wire method is described in detail, and the properties of a thick quadrupole lens are reviewed as an introduction to the results obtained with this method. The construction of the lens is briefly described, and the magnetic measurements made by the Hall effect and the floating wire measurements are given. The source of linearity faults detected with the floating wire could be determined from the Hall effect. The validity and utility of these two measurement methods are established. (J.S.R.)

24385 (CERN-61-17) SCATTERED-OUT EXTERNAL PROTON BEAM AT THE CERN PROTON SYNCHROTRON. B. Dayton and H. Winzeler (European Organization for Nuclear Research, Geneva). May 17, 1961. 32p.

Trajectories were calculated in both horizontal and vertical planes for the proton beam elastically scattered from target no. 1 in the CERN proton synchrotron. The momentum distribution of the beam was determined. Means of increasing the intensity of the beam is discussed. (D.L.C.)

24386 (DESY-A-2.76) ZUR ENTWICKLUNG DER QUADRUPOLLINSEN. II. (On the Development of Quadrupole Lens. [Part] II). H. Hultschig (Deutsches Elektronen-Synchrotron, Hamburg). Apr. 20, 1961. 11p.

The quadrupole lens discussed in Part I required too large a power consumption. In the present article a quadrupole lens with increased coil cross section and rectangular coil shape is considered. The lenses discussed are symmetrical. A quadrant of the quadrupole lens with coil corrector and a 200-mm coil is shown. The profile was measured in the analog model and the potential lines show a quadrupole field within the measurement accuracy of 5%. (J.S.R.)

24387 (ORNL-3104(p.71-82)) ION PRODUCTION, ACCELERATION, AND INJECTION. R. C. Davis, R. R. Hall, G. G. Kelley, et al. (Oak Ridge National Lab., Tenn.).

Test-stand performance of the von Ardenne ion source under development for DCX-2 reached 70 ma continuous current of mixed hydrogen ions at 570 kv for half an hour, the test was ended by target failure. Initial testing of a rotating-target titanium pump shows a sticking factor of unity when pumping a deuterium ion beam at 4 kw/in.^{2}. A model was installed on DCX-1 for testing. Electrostatic deflection appears to offer a practical way of steering a 600-kev ion beam as it enters a magnetic field. A 50-ma, 21-kev beam is easily deflected 2 in. in a magnetic field of 2600 gauss. The successful application of such a device in DCX-EP-B would increase the radius of the volume available to the wrapped-up beam by a distance equal to the radius of the injection snout, or about 2.8 in. Successful tests of the neutralized-beam injector prototype were made. Ninety-five to ninety-nine per cent of the monoenergetic electron beam may be passed through the hollow reflux ion source and ion accelerating gap. Qualitative measurements on the behavior of the ion beam in the presence of the injected electron beam indicate that space-charge blowup of the ion beam is reduced. Results for various acceleration voltages from 5 to 15 kv, injected electron currents up to 150 ma, and ion currents of about 1 amp are discussed. (auth)

24388 (TID-13221) THE UNIVERSITY OF MICHIGAN 83-INCH CYCLOTRON. Progress Report No. 4, April 1, 1961 to July 1, 1961. W. C. Parkinson and R. S. Tickle (Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts). July 1961. Contract AT(11-1)-921. 10p. (ORA-03763-4-P)

Progress on the building to house the cyclotrons and on the design and construction of the 83-in. cyclotron is reported. All major exterior construction on the three units of the building was completed. The magnetic field regulator of the cyclotron was constructed in a semi-final form and tested. The mechanical equipment to be used in the precision measurement of the magnetic field was completed. Magnetic field measurements were made for several proposed spiral shim configurations. The preliminary design of the vacuum system was completed. Computer studies on the ion-optical properties of the analyzer magnets were also completed. (M.C.G.)

24389 (UCRL-9671) BEVATRON OPERATION AND DEVELOPMENT. XXVIII. [Period Covered] November 1960–January 1961. Walter D. Hartsough and William W. Salsig (California. Univ., Berkeley. Lawrence Radiation Lab.). May 8, 1961. Contract W-7405-eng-48. 13p.

The Bevatron operated an average of 80% of the scheduled operating time with the exception of one 5-day shutdown period for emergency maintenance of the motor generator sets. The machine was shut off 19% of the scheduled operating time because of component failure and 1% at the request of the user. During and following the Christmas shutdown period an ultrasonic inspection was made of the flywheel keyway on each of the motor generator sets. No faults were apparent. Charpy samples were taken from the inspection bore in the flywheels. Subsequent "vee notch" Charpy impact tests indicated that the flywheels are operated in a brittle region rather than in the ductile range expected. The research program again was devoted mainly to study of π- and K-meson interactions. (auth)

24390 (CEA-tr-A-451) SOURCES D'IONS POUR DES RECHERCHES DE PHYSIQUE NUCLÉAIRE. (Ion Sources for Research in Nuclear Physics). O. Reifenschweiler. Translated into French from Ann. Physik (6), 14: 33-?(1954). 37p.

A review is presented on ion sources for accelerators. First the principal modes of operation are treated. A more profound study is then given of the operation and properties of ion sources with simultaneous production and extraction of ions and of sources with ion extraction being a subsequent operation to production. (J.S.R.)

24391 (CEA-tr-A-886) ACCELERATEURS LINEAIRES POUR RADIOGRAPHIE. (Linear Accelerators for Radiography). H. Schopper. Translated into French from Materialprüfung, 2: No. 2, 38-44(1960). 36p.

High-frequency generators recently constructed for the needs of radio technology (klystrons, for example) have permitted the realization of electron linear accelerators producing a bremsstrahlung with high quantum energies (10 Mev or more) and high doses (several 1000 r/min at a distance of 1 m). Their construction is simple and the weight is relatively reduced. Thus, these accelerators offer new possibilities for the radiography of thick pieces. The laws of physics are used to evaluate the efficiency of known radiation sources. Thus, the x-ray yield increases

as a function of the electron energy, whereas the sharpness of the image is softened when the aperture angle of the beam decreases and when the penetration power passes through a maximum. The constituent parts and the operation of electron linear accelerators are described, and the specifications are discussed using some examples. (tr-auth)

24392 (CEA-tr-A-938) GENERATEUR DE FAISCEAUX ELECTRONIQUES ET IONIQUES DE HAUTE INTENSITE. (Generator for Bunching Electrons and Ions of High Intensity). H. Froelich. Translated into French from Nukleonik, 1: No. 5, 183-8(1959). 29p.

The design and operation of a high-intensity generator is described. It yields, in its present version and in continuous operation, electron currents up to 7.5 amp and hydrogen ion currents up to 1 amp. In pulsed operation these values can be increased several times according to the length and frequency of the pulses. (tr-auth)

24393 DOUBLE ELECTRO-STATIC DEFLECTION OF ELECTRON BEAMS WITHOUT ABERRATIONS. Koichi Kanaya and Hiaszo Kawakatsu (Electrotechnical Lab., Tokyo). Denki Shikensho Iho, 25: 241-52(1961). (In English)

An electron beam passing through a deflecting field is, in general, subject to aberrations such as distortion, astigmatism, and coma. The deflection equations are formulated by developing the theory of deflection. Furthermore, it is shown that the caustic figures of the deflected beam converged at the focal point show complicated patterns of aberration. It is suggested that deflections free from coma, astigmatism, and distortion can be achieved by means of a double deflection system, since the aberration of deflection in such system can, in principle, be compensated if the deflection fields are properly distributed. (auth)

24394 MEASURABLE RADIATION IN THE VICINITY OF A BETATRON DURING THE EMISSION OF HIGH ENERGY ELECTRONS. P. G. Paleani Vettori and F. Pigorini. Nuntius Radiol., 27: 21-36(1961).

Results of ionimetric measurements in the vicinity of the 15-Mev SRW betatron are reported. Ionization chambers positioned on the equipment itself recorded a considerable activity. On top of the betatron high values, up to 36r per 100 rad of the primary beam are detected. The emitted radiation follows a path almost opposed to that of the primary beam. The analysis of the nature and energy of these parasitic emissions leads to the hypothesis that some of the accelerated electrons do not go through the accelerator diaphragm but are scattered in the walls and shields of the accelerator. (EURATOM)

24395 RADIATION MEASUREMENTS IN THE VICINITY OF A BETATRON EMITTING HIGH ENERGY ELECTRONS. P. G. Paleani Vettori and F. Pigorini. Nuntius Radiol., 27: 125-37(1961).

The radiations measured in proximity of the 15-Mev SRW betatron were studied from the standpoint of the protection problems. The ionization values at the surface and in the depth shown by a rubber dummy placed in different points are reported. The importance of the observed phenomena is discussed as far as the dose for the critical organs is concerned and it appears that with the equipment used, 15 Mev electrons cannot harm patients or attendants. (EURATOM)

24396 ACCELERATOR ENERGY CALIBRATIONS. Jerry B. Marion (Univ. of Maryland, College Park and Convair, San Diego, Calif.). Revs. Modern Phys., 33: 139-47(Apr. 1961).

Standards for accelerator energy calibrations are discussed. Several absolute calibration devices, which utilize electric or magnetic fields, are noted. Reactions $B^{11}(p,\gamma)C^{12}$, $F^{19}(p,\alpha\gamma)O^{16}$, $Al^{27}(p,\gamma)Si^{28}$, and $Li^{7}(p,n)Be^{7}$ give four high-yield narrow resonances and one sharp neutron threshold. The resonance and threshold energies are evaluated, and recommended values are given to be used as primary energy standards. Eight secondary standard resonances and thresholds are found in the reactions $Li^{7}(p,\gamma)Be^{8}$, $Be^{9}(p,\gamma)B^{10}$, $F^{19}(p,\gamma\alpha)O^{16}$, $C^{13}(p,\gamma)N^{14}$, $Ni^{58}(p,\gamma)Co^{59}$, $Be^{9}(p,\alpha\gamma)Li^{6}$, and $C^{13}(p,n)N^{13}$. Other resonance and threshold energy standards are noted. A further technique is described in which the energy of α particles is compared directly to the voltage necessary to accelerate $(Lu^{175})^{+}$ ions to the same $B\rho$ value. (T.F.H.)

24397 HEAVY-ION LINEAR ACCELERATOR. E. L. Hubbard (Univ. of California, Berkeley), W. R. Baker, K. W. Ehlers, H. S. Gordon, R. M. Main, N. J. Norris, R. Peters, L. Smith, C. M. Van Atta, F. Voelker, C. E. Anderson, R. Beringer, R. L. Gluckstern, W. J. Knox, M. S. Malkin, A. R. Quinton, L. Schwarcz, and G. W. Wheeler. Rev. Sci. Instr., 32: 621-34(June 1961). (UCRL-9453)

Two linear accelerators are built for the acceleration of ions in the mass region from helium to argon. Each accelerator consists of two 70 Mc cavity resonators of the Alvarez design. Ions with a charge to mass ratio $e/m \geq 0.15$ times the e/m of a proton are injected into the first cavity of the linear accelerator with a Cockcroft-Walton accelerator. In the first cavity the ions are accelerated from the injection energy of 0.07 Mev/nucleon to 1.0 Mev/nucleon. They are then stripped to an $e/m \geq 0.3$ and accelerated to the final energy of 10 Mev/nucleon in the second linac cavity. (auth)

24398 SENSITIVE MONITOR OF CYCLOTRON BEAM POSITION. B. Gottschalk, A. M. Koehler, and D. J. Steinberg (Harvard Univ., Cambridge, Mass.). Rev. Sci. Instr., 32: 744-5(June 1961).

A device is described by which cyclotron beam position fluctuations may be monitored. An ionization chamber is provided that contains a split foil; each side of the foil is connected to an electrometer circuit. The beam normally passes through the opening between the foils. Changes in beam position cause an unequal flux to fall on the foils, and this difference is detected and recorded by the electrometer circuits. (T.F.H.)

24399 INVESTIGATION OF ORBITS IN STRONG-FOCUSING ACCELERATOR WITH CONSTANT MAGNETIC FIELD. V. K. Grishin. Vestnik Moskov. Univ. Ser. III. Fiz., Astron., No. 5: 6-10(Sept.-Oct. 1960). (In Russian)

Particle trajectories in a strong-focusing accelerator with constant field are analyzed by a successive approximation method. The derived equations established the bond between magnetic field parameters and dynamic characteristics of the accelerator. (tr-auth)

24400 NON-INERTIAL SYSTEM CALCULATIONS IN LINEAR BETATRON THEORY. Ts. I. Gutsunaev. Vestnik Moskov. Univ. Ser. III. Fiz., Astron., No. 5: 11-18(Sept.-Oct. 1960). (In Russian)

A quotient solution for relativistic electron motion in an axially symmetric magnetic field shifting irregularly along the symmetry axis was derived by converting to the noninertial system of coördinates. The law of accelerated electron energy build-up and motion stability is analyzed. (tr-auth)

24401 LINEAR ION ACCELERATORS. Jacques Pottier (to Commissariat a l'Energie Atomique). British Patent 871,415. June 28, 1961.

The design of a linear ion accelerator is described. The accelerator consists of a cylindrical cavity, two series of drift tubes disposed longitudinally of the cavity axis, and at least two conductive plates. The plates connect the tubes electrically. The plates extend longitudinally of the cavity between the tubes and the cavity wall. These plates are arranged to equalize the frequencies of the cavity sections and to maintain a maximum potential difference between the tubes of the two series. The accelerator described is adapted to resonate in H_{111} mode. To adapt the accelerator to resonate in H_{211} mode, four conductive plates must be disposed in two mutually perpendicular diametrical planes of the cavity and serve as supports for the tubes. (N.W.R.)

Plasma Physics and Thermonuclear Processes

24402 (AD-225053) WAVE PROPAGATION AND OSCILLATIONS IN PLASMA BODIES. Technical Final Report, April 1, 1958–March 31, 1959. W. O. Schumann (Munich. Technische Hochschule). Contract AF61(052)-79. 42p.

The propagation of electromagnetic waves in the plasma with the aid of a plasma-cable is subject of the present study. Plasmas of mercury-vapor discharges with direct current and glow-cathode were investigated. The plasmas were burned in long and thin glass tubes. These glass tubes were closely fitted into a brass tube which contained a slot over the total length as in a measuring line. The high frequency energy, delivered by means of a power-transmitter, was capacitively coupled at one end of this plasma cable and at the other end reflected by short circuit. The measurements of the standing waves were made by the aid of a capacitive probe that fitted into the slot of this metal tube and could be slid over the whole length of the plasma. A longitudinal magnetic field of sufficient homogenity created a magnetic intensity of 1000 Gauss throughout the plasma cable. The transmitter was disconnected and the self-oscillations of the apparatus were determined. Thereby plasma-acoustic oscillations of about 30 kc were observed which could be explained as transverse oscillations. Their corresponding electron temperatures were in full agreement with the ones obtained by other methods. Between 100 and 200 kc there was a wide band of noise. Furthermore between 600 and 5000 Mc self oscillations of plasma (due to plasma disturbances) were measured that indicated a maximum at 920 Mc. (auth)

24403 (AD-248728) MAGNETOHYDRODYNAMICS AND ENERGY CONVERSION. Report for Period Ending September 15, 1960. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Oct. 15, 1960. Contract AF33(616)-3984. 16p.

The magnetohydrodynamic Rayleigh problem is discussed for a nonconducting flat plate immersed in an incompressible conducting fluid and transverse to a magnetic field. Solutions are derived for transformed space, $\epsilon = 1$, $t \rightarrow \infty$, and $\epsilon \ll 1$. Shock tube experiments, in which strong interactions between plasma gas flow and magnetic fields were studied, are reported. (D.L.C.)

24404 (AD-250673) INVESTIGATIONS ON THE DIRECT CONVERSION OF NUCLEAR FISSION ENERGY TO ELECTRICAL ENERGY IN PLASMA DIODE. Final Report. (General Motors Corp. Research Labs. Div., Detroit). Dec. 31, 1960. Contract Nonr-3109(00). 149p.

Experimental and theoretical studies were made on the fission-fragment noble-gas plasma diode for the direct conversion of nuclear energy into electric energy. In the experimental study, measurements were made on the following items: (1) electron emissivity of uranium-bearing cathodes, (2) spectra of cesium plasmas, and (3) properties of a pulsed noble-gas plasma diode. (D.L.C.)

24405 (AD-253125) SUPERSONIC TWO-DIMENSIONAL MAGNETOHYDRODYNAMIC FLOW. Research Report No. 39. F. Fishman, J. Lothrop, R. Patrick, and H. Petschek (Avco Mfg. Corp. Avco Research Lab., Everett, Mass.). Feb. 1959. Contracts- AF04(647)-278 and AF49(638)-61. 51p.

A perturbation theory was applied to the supersonic flow of a conducting fluid through the magnetic field of a circular solenoid. Calculations describing the lift and drag forces on the solenoid as well as the gas conditions everywhere in the flow field in the limit of weak interaction between the magnetic field and the flow are presented. Experiments were conducted in a 6-in. diameter chemically driven shock tube. Hydrogen was used as the driver gas and argon or a mixture of 90% argon and 10% oxygen was used as the working gas. The required solenoidal magnetic field was produced by a helical coil placed across the shock tube and supported by O-ring sealed feeds through the windows of the test section. Calibrated view camera pictures of the light emitted by the gas are in agreement with the predictions based on the perturbation theory. For very strong magnetic fields the experimental flow pattern became similar to the flow pattern around a solid cylinder. Estimates of the experimental lift forces indicated a lift coefficient of about 0.4 and a lift-drag ratio of approximately unity. (M.C.G.)

24406 (AD-253127) DYNAMICS OF ELECTRON BEAMS AND PLASMAS. Technical Note No. 5. Eugene P. Gross (Brandeis Univ., Waltham, Mass.). [nd]. Contract AF49(638)-27. 27p.

Various descriptions of electron beams and plasmas, their limitations, and the type of information that they may give are discussed. Theoretical attempts to replace the self-consistent theory of electron beams by less detailed, hydrodynamic descriptions, attempts to solve the set of equations resulting from this theory as they stand, and approaches which aim at a more detailed description than is afforded by this basic set of equations are reviewed. Work on the dynamics of plasmas with random velocity distributions which used the basic set of kinetic equations was examined. The interaction of sharply defined beams of charged particles with a plasma was investigated. Theories which attempt a more detailed description of processes in a plasma or electron beam are discussed. (M.C.G.)

24407 (AFCRL-334) ON THE LIMITING VELOCITY FOR A ROTATING PLASMA. Research Report 101. Shao-Chi Lin (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). Apr. 1961. Contract AF19(604)-7458. 51p.

A quasi-steady state solution was obtained for a homogenous plasma undergoing simultaneous ionization and rotation in a crossed electric-magnetic field. It was found that the ordinary electron-impact ionization process, when supported by the Landau ion-electron heat transfer mechanism, will be sufficiently rapid to provide a close coupling between the kinetic energy of the ion and the ionization energy of the neutrals under a wide range of conditions. The results can be used to interpret the limiting velocity observed by Alfvén and Fahleson in some recent rotating plasma experiments. The same results can also be used to predict the occurrence of similar limiting velocity in some rectilinear plasma accelerators. (auth)

24408 (AFCRL-462) ACCELERATION OF PLASMAS BY INDUCTIVELY GENERATED ELECTROMAGNETIC FIELDS. Final Report. David B. Miller (Michigan. Univ., Ann Arbor. Coll. of Engineering). Apr. 1961. Contract AF19(604)-4557. 234p. (UMRI-02836-10-F)

A discussion is given of the theory and experimental behavior of an induction electromagnetic accelerator, which employs a time-varying current in a coil to generate the force-producing electric and magnetic fields. Some aspects of the induction accelerator which can be derived theoretically are first brought out. These begin with a study of isolated particle behavior within a cylindrical coil. Charges gain energy from the azimuthally directed electric field; their paths are turned in the radial and axial directions by the magnetic field, and they eventually are ejected out the end of the coil. The exact paths of electrons and helium and argon ions under various field conditions of magnitude and frequency are calculated by analog computer techniques, and from these calculations are obtained the velocity and angle which the ejected particles ultimately obtain. One important result which comes out of this particle analysis is the quantitative dependence of ejection characteristics on initial position of the particle. Another significant item is the marked difference in behavior when the field period is much less than and much more than the time taken for the particle to be ejected from the accelerator. Induction acceleration of plasmas is theoretically considered first under the simplifying assumption that the coil is very long. This eliminates radial magnetic field components and thrust in the axial direction, but it realistically treats the radial motion, an important energy-transferring process in the experimental device. The effect of self-fields, electric caused by charge separation and magnetic caused by the gas current, on the radial motion is extensively studied; this reveals that even at quite low densities the particles are bound to one another by these fields, and it leads to the calculation of the radial motion of such low density plasmas. The radial dependences of magnetic field and current density within the ionized gas are shown to be approximated by Bessel functions. At high densities a skin current is shown to form and to prevent penetration of the magnetic field into the interior of the plasma. For these high densities a "snowplow" analysis is used to calculate the radial motion of the plasma. The axial motion of plasma within a finite sized coil is considered. Qualitatively, it is argued that the majority of energy in axial motion arises from energy which is transmitted to the plasma by radial compression and then is converted to axial motion in the diverging magnetic nozzle. Characteristics of the flowing gas which can be obtained from observation of the advancing shock wave are brought out. Experiments using an induction accelerator are described. The accelerator is a 10-cm long by 10-cm diameter, single turn, cylindrical coil driven by a 37.5-μfd capacitor bank. Capacitor voltages in the 5- to 10-kv range were used. Ionization of the gas within the coil was accomplished partly by a high frequency preionization circuit and partly by the accelerator field. Data on helium and argon over the general pressure range of 0.010 to 1.00 mm of Hg are reported. Specifically, kinetic characteristics of radial and axial motion, and momentum and energy and internal structure of current and charge of the accelerating ionized gas were studied. The separate measurements are discussed and correlated whenever possible with each other and with the theory. Axial velocity of the gas as it emerges from the coil is typically 0.5 to 10 cm per microsecond. Energy in the amount of approximately 10 to 50 joules is transferred from the circuit to the gas; this represents up to 10% of the energy available in the magnetic field of the coil, and about half this transferred energy goes into directed motion of the gas. Ion temperatures, calculated from observations of the radial compression and axial shock, are in the 25,000 to 100,000°K range; electron temperature, measured for one pressure by an electric probe, is about one-third the concurrent ion temperature. (auth)

24409 (AFCRL-TR-60-429) RESEARCH DIRECTED TOWARD THE STUDY OF THE PROPERTIES OF A PLASMA THAT MAY LEAD TO A NEW TYPE OF EM GENERATOR. Final Report. William G. Guindon (Boston Coll., Chestnut Hill, Mass.). Sept. 19, 1960. Contract AF19(604)-2195. 15p. (AD-248587)

A description is given of a 36-kilojoule capacitor bank and related apparatus. A summary description is included of the following experiments: observation of the motion of ionized gas through a pulsed magnetic field; pulsed Zeeman and Paschen-Back Effect measurements; and work toward the development of a pulsed air-core betatron. (auth)

24410 (AFOSR-750) ON THE APPLICATION OF TWO-PARTICLE DISTRIBUTION FUNCTIONS. J. M. Burgers (Maryland. Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). Apr. 1961. Contract AF49 (638)-401. 32p. (BN-243)

Paper was presented at the PBI Symposium on "Electromagnetics and Fluid Dynamics of Gaseous Plasma," New York, Apr. 4–6, 1961.

The d-c electric conductivity of a fully ionized gas is calculated using a moment equation derived from the Boltzmann equation with a collision term expressed with the aid of a two-particle distribution function. The two-particle distribution function is obtained from an equation given by the kinetic theory, in which the three-particle distribution function and two integrals depending upon other two-particle distribution functions are replaced by expressions involving the Debye potential. Further approximations are introduced by the assumption of Maxwellian functions (with unknown flow velocities) for the single-particle distribution functions occurring in this equation. The integral depending on the two-particle distribution function occurring in the moment equation derived from Boltzmann's equation can then be worked out. The expression for the electric conductivity given by this procedure has a main term which for low-flow velocities agrees with that given by the usual theory for collisions depending upon Coulomb forces, while for high-flow velocities this term gives the runaway effect. Two correction terms are obtained: one, which may be of some importance, depending upon the increased concentration of particles of opposite charge around a given particle; and the other, representing a minor effect caused by a distortion of the Debye cloud by the exterior electric field. (auth)

24411 (CF-61-7-1) CALCULATION OF THE "NEGATIVE MASS" INSTABILITY FOR DCX-1. T. K. Fowler (Oak Ridge National Lab., Tenn.). July 3, 1961. 11p.

The threshold for an instability by which space charge accumulates in a ring of ions circulating in a magnetic field with negative radial gradient is calculated for DCX-1. With present low densities, the energy spread necessary to quench the instability, a few tens of kev is of the order of the observed energy spread. (auth)

24412 (JPL-TR-32-66) APPLICATION OF SPECTROSCOPIC TEMPERATURE MEASURING METHODS TO DEFINITION OF A PLASMA ARC FLAME. Robert G. Nagler (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Jan. 27, 1961. Contract NASw-6. 11p.

Numerous spectroscopic temperature measuring methods

were evaluated as to their applicability in defining the flame from a clean plasma generator (i.e., no carbon electrode contamination). The techniques needed to apply the recommended methods are outlined. The recommended methods include simultaneous solution of the Saha intensity equations for all constituents, comparing intensities using the relative transition probabilities on a single element, comparing intensities relative to a single known temperature and intensity, and measuring the electron density from the electronic continuum. The methods which were thought to be inadequate are outlined briefly and the reasons for discarding them are given. (auth)

24413 (LAMS-2546) A SIMPLIFIED PLASMA PROPELLER. H. W. Lewis (Los Alamos Scientific Lab., N. Mex.). Apr. 6, 1961. Contract W-7405-Eng-36. 16p.

A preliminary discussion is given of some of the possible parameters of a plasma propeller: a device in which the output of a plasma thermocouple is taken as exhaust energy rather than as electrical energy. The design of a possible experimental working model is briefly described. (auth)

24414 (LAMS-2570) QUARTERLY STATUS REPORT OF THE LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM FOR PERIOD ENDING MAY 20, 1961. (Los Alamos Scientific Lab., N. Mex.). June 1961. Contract W-7405-eng-36. 43p.

The width of the He II 4686 A line was used to estimate the temperature of trapped helium ions injected into a simple picket fence magnetic field. With the assumption of a Maxwellian distribution, an average ion temperature of ~100 ev was measured under optimum conditions in the interval of 50 to 80 μsec after the hydromagnetic gun is fired. The electron energy was measured by the ratio of the intensities of the He I 4921 A and 4713 A lines and found to be constant, ~20 ev, between 50 and 80 μsec. The performance of the gun used in the bakeable picket fence experiment was investigated as a function of center electrode polarity and method of switching. Measurements of the neutron yield ($\sim 5 \times 10^4$ per discharge) produced by the deuterium jet interacting with deuterium surface layers on a 10-cm diameter glass plate 45 cm from the gun were consistent with plasma jet densities of $\sim 10^{13}$ deuterons/cm^3 and ~25 kev energy. A particle detector was constructed which measures ion densities in plasma jets produced by fast hydromagnetic guns. Perturbations of the feedpoint (~3.7 cm thick) of the one-turn coil on the magnetic field with the Orthogonal Pinch experiment were studied by building a special symmetric coil fed by a parallel plate transmission line ~0.2 cm thick. The neutron yield with the symmetric coil gave one-half the neutron yield with the thick feedpoint. Metal fins approximating a second feedpoint were attached to both coils with a decrease in neutron yield of one-third with the thick feedpoint and an increase in the neutron yield by only ~10% for the symmetric coil. It was concluded that the mechanism of neutron production in this machine is influenced by the magnetic asymmetry introduced by the non-symmetric cross section of the driving coil geometry. In the resonant helix experiment the orbits of 2-kev electrons passing through the helix in the forward and backward directions were followed by a computer for a number of longitudinal velocities of the electron. It is found that in the forward direction there is in general a step increase in the longitudinal energy. Containment times were determined by measuring the diamagnetism produced by the trapped electrons and by the loss rate of electrons out the far mirror. The problem of the collisional relaxation of a fast test charge moving through a gas of field electrons and ions was described by the asymptotic form of the Fokker-Planck equation, and an analytic solution was obtained. The results are used to study the production of a second peak in the velocity distribution function. In the study of the scattering of microwaves by plasmas, work is continuing on the study of the incoherent scattering induced by external fields. In the colliding plasma experiment the fast components were observed to interact and produce plasma at temperatures of 3 kev at particle densities of $\sim 10^{14}$ per cm^3. The slow components interacted with considerable conversion of longitudinal to random energy producing $kT_i \sim 100$ ev and density $\sim 10^{15}$ per cm^3. The plasma from a coaxial gun was observed to penetrate a transverse magnetic field and to polarize as expected. In Scylla III the plasma was observed to develop an m = 2 flute instability with superimposed rotation of the plasma as a whole. The plasma tended to stabilize when the compression coil is lengthened. New spectral lines of F VIII and F IX were excited in Scylla I and classified. Line broadening measurements of the impurity lines in Scylla I give equivalent O, F, and Ne ion temperatures much larger than the deuteron temperature inferred from broadening of the d-d proton line. A new magnetic compression experiment is being designed to excite plasma in long coils. The low-inductance cabled shelf of Zeus generated interest in the use of the system as a power crowbar in a new Scylla experiment. It was found that, although Zeus has always been positive, parts should be charged negative. (auth)

24415 (MATT-Q-13) QUARTERLY REPORT COVERING THE PERIOD OCTOBER 1–DECEMBER 31, 1960. (Princeton Univ., N. J. Project Matterhorn). Feb. 8, 1961. Contract AT(30-1)-1238. 30p.

Continuing studies of confinement reinforced previous conclusions. Measurements of electron decay in the B-3 stellarator during ohmic heating indicated a diffusion coefficient, D, varying as T/B, in agreement with the Bohm formula, but with a numerical coefficient some three times greater. On the other hand, measurements of density profile in a quiescent cesium plasma, with no current flowing along the lines of force, indicated a diffusion coefficient varying as $1/B^2$. Plausible assumptions about the recombination coefficient yielded a value of D less than the Bohm value by two orders of magnitude. The study of recombination in a helium plasma after termination of ohmic heating in the B-1 stellerator, showed that over an appreciable range of physical conditions the observations can be explained by the assumption that three-body recombination, involving an ion and two electrons, is the dominant process. Spectroscopic measures of the absolute photon yield and the measured decay rate of electron density as a function of temperature and electron density were in agreement with theory. The variation of temperature with time agreed with theoretical calculations based on heating by collisional de-excitation of the metastable atoms formed in the course of recombination. The C stellarator is now in the final stage of assembly. (auth)

24416 (NP-10356) VELOCITIES OF ELECTRICALLY EXCITED SHOCK WAVES IN SMALL TUBES FILLED WITH DEUTERIUM GAS AT LOW PRESSURES. E. John Eastmond and Eugene B. Turner (Space Technology Labs., Physical Research Lab., Los Angeles). Oct. 3, 1958. 22p. (GM-TR-0127-00497)

Plasmas produced by electrically excited shocks were investigated for use in a device for producing high temperatures. It was necessary to determine the shock velocities in order to be able to calculate the temperature and electrical conductivity of the plasma. Velocity measurements were made in tubes of various diameters at-

tached coaxially to the ring electrode of a tapered-tube driver assembly. In the 3-in.-diameter tubes the velocities were measured with a revolving mirror camera. An image-converter tube camera was used to measure velocities in the smaller diameter tubes. The shorter ring electrode gave faster shock velocities and the shorter tapered tube gave the fastest shocks. Maximum velocities in the observation tubes were reached at deuterium pressures of 50 to 100 microns. Higher velocities at lower pressures were obtained with the larger tubes. It was concluded that the plasma injector system consisting of a long tapered tube with a 1-in.-long ring electrode and a $\frac{5}{8}$-in. spacer is the best of those tested. (M.C.G.)

24417 (OOR-2262:2) PLASMA DIAGNOSTICS WITH VACUUM ULTRAVIOLET RADIATION. Final Report. G. L. Weissler (University of Southern California, Los Angeles). Dec. 30, 1960. Contract DA-04-495-ORD-1409. 10p. (AD-250338)

The possibilities of using radiation of the vacuum ultraviolet region as a diagnostic tool for high-temperature plasmas are being investigated. Kolb-type tubes were used to produce, by condenser impulse discharges, magnetically driven plasmas. The vacuum ultraviolet emission spectrum from such plasmas was studied. The emission line intensities were determined as a function of time. The extent to which the cold gas in the shock tube is being modified by the tremendous radiation flux from the condenser discharge which initiates the plasma is being studied. Various areas behind the shock front were probed with light from an auxiliary source. (M.C.G.)

24418 (ORNL-3104) THERMONUCLEAR DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1961. (Oak Ridge National Lab., Tenn.). May 31, 1961. Contract W-7405-eng-26. 159p.

Included are summaries of studies of: DCX-1 operation and performance; DCX-2 design and engineering; plasma physics; vacuum arcs; ion production; acceleration and injection; plasma theory and computations; instrumentation; magnetics; cross-section measurements; vacuum systems and techniques; ball-lightning; and design and engineering. Separate abstracts were prepared for the 11 sections. (B.O.G.)

24419 (ORNL-3104(p.1-16)) DCX-1 OPERATION AND PERFORMANCE. C. F. Barnett, J. L. Dunlap, R. S. Edwards, et al. (Oak Ridge National Lab., Tenn.).

Measurements were made of the energy distribution of the H^0 particles that escape from the storage ring in DCX. From the energy spectra, the energy distributions of the H^+ particles within the ring are inferred. When either arc dissociation of the injected H_2^+ ions is used, or dissociation in the residual gas, the energy spectra of the H^0 particles are seen to broaden as the current of injected 600-kev H_2^+ ions is increased from 0.1 to 2.5 ma, and the mean energies characteristic of the spectra are observed to decrease by a few tens of kilovolts. In the case of arc dissociation, the mean containment time of the protons is found to decrease from 2.6 to 1.7 msec as the injected H_2^+ current is increased from 0.1 to 2.3 ma. From electromagnetic pickup signals, light signals, and a time analysis of energy-selected escaping neutrals, evidence appears for a bunching or nonuniformity in the distribution of the trapped protons in the storage ring. The bunching is more pronounced at the higher injection currents. An energy balance suggests that the rate of energy loss from the stored protons is greater at the higher injection current than at the lower injection current. The cause of the bunching is not yet understood. Sundry improvements in the vacuum technique of DCX are described, including the installation of titanium evaporative pumps that have lowered the base pressure by a factor of 10 to 3×10^{-8} mm Hg with a measured pumping speed for hydrogen of 50,000 liters/sec at 10^{-7} mm Hg, the testing of a large Vaclon pump, and the testing of a Redhead gage. A new ion source was installed, in which mass analysis is applied before the 600-kv acceleration, so that only the H_2^+ beam is accelerated. It is expected that this will furnish considerably higher injection currents than previously available. (auth)

24420 (ORNL-3104(p.17-28)) DCX-2 DESIGN AND ENGINEERING. P. R. Bell, J. S. Culver, S. M. DeCamp, et al. (Oak Ridge National Lab., Tenn.).

Magnet coils were calculated as to shape, current density, and location to meet exacting requirements in DCX-2; the requirements include uniformity of the field over a region 52-in. long and 18-in. in diameter, with a properly located dip of 1.6% in field strength near the injection snout and a rise by a factor 3.3 into the mirrors at either end. Orbit calculations show that absolute containment holds for the injection H_2^+ ions. Helical orbits are calculated for both H_2^+ and H_3^+; substantial, and perhaps useful, precession can probably be found in the reflection region $43\frac{1}{2}$ in. to $45\frac{1}{2}$ in. from the midplane. A summary of the present status of the design and construction of DCX-2 is given. (auth)

24421 (ORNL-3104(p.29-45)) PLASMA PHYSICS. R. A. Dandl, H. O. Eason, R. J. Kerr, et al. (Oak Ridge National Lab., Tenn.).

Cyclotron resonance heating of electrons in a microwave cavity led to conditions in which densities exceeding 10^{10} electrons/cm^3 and mean energies of about 10 kev and maximum energies of several hundred kev are apparently established. Ionic sound waves occurring in a throat region near the cathode of a vacuum arc were found to account for oscillations, for blowup, and for other properties described by Neidigh during operation in mode I and mode II arcs. Harmonics of the oscillations are producible, and the frequencies are found to vary appropriately with ionic mass and with arc length. They also show appropriate independence of magnetic field strength, gas pressure, arc current, and arc voltage. The ionic sound wave theory is shown to account fairly well for plasma oscillations found in certain mercury vapor discharges. (auth)

24422 (ORNL-3104(p.83-96)) THEORY AND COMPUTATION. Philip Burt, E. G. Harris, Albert Simon, et al. (Oak Ridge National Lab., Tenn.).

The stability of a plasma which is in the form of an infinite cylindrical shell was considered. The ions all move with constant angular velocity (ω_{ci}) about the axis of the cylinder; the electrons are cold. The resultant behavior is very close to that of an infinite plasma with anisotropic velocity distribution. Instabilities are predicted for electron plasma frequencies which are integral multiples of ω_{ci}. The amplitude of the instability should be severely limited by nonlinear effects at low densities. Exact coefficients were obtained for a plasma with an arbitrary zero-order velocity distribution, an arbitrary applied radiation field, and an arbitrary mixture of ion species. A Fokker-Planck equation for the radiation field oscillators was deduced from the Liouville equation. The method of Gryzinski was used to calculate the excitation of the first excited state of hydrogen. The resultant agreement with experiment is poor. Several changes in a code to solve the coupled steady-state Fokker-Planck equations for ions and electrons led to preliminary success. A test case is seen to relax to a Maxwell distribution as it should. Previous calculations of the critical ion current in an OGRA-type device were extended to include

degradation of the ion energy by energy transfer to cold electrons released by the ionization of the neutral background. A typical plot, showing the extent of corrections to the "S-curve" is included. For injection of beams of neutral atoms with trapping by ionization, and for molecular-ion injection with trapping by dissociation, estimates of the limitations imposed by available phase space upon accumulable particle densities indicate that the limitation lies far above the region of controlled thermonuclear interest. For the injection of neutralized beams of ionized atoms on the other hand, the limitation may be of more nearly practical importance; the limitations are relaxed if the neutralized beams contain molecular ions, and dissociation is again invoked as a trapping mechanism. (auth)

24423 (ORNL-3104(p.97-8)) INSTRUMENTATION. R. L. Brown (Oak Ridge National Lab., Tenn.).

The possible hazard of water flow failure in one of the numerous water paths of the coils in DCX-2 make individual over-temperature detection highly desirable. Results of tests on eight inexpensive bimetallic thermoswitches are described. (auth)

24424 (ORNL-3104(p.99-120)) MAGNETICS. D. L. Coffey, J. E. Simpkins, W. F. Gauster, et al. (Oak Ridge National Lab., Tenn.).

Codes and techniques are described, by which magnetic mirror fields with extremely homogeneous central zones were designed. The magnetic field of DCX-EP-B, a product of these methods, is described. It is very difficult to synthesize magnetic fields with extremely homogeneous central zones and specified "field dips" for ion injection between the mirrors and the central zone. This task can be considerably facilitated if two theorems are used, which state that optimized magnetic fields can be obtained by superposition of appropriately optimized component fields. The first theorem applies to the case of a known flux density B_0 in the homogeneous central zone; the second considers the flux density as an unknown. The magnetic fields for DCX-2 and DCX-EP-B were determined with the use of these superposition theorems. For the relativistic movement of a charged particle in a nonstationary electromagnetic field the radius of curvature ρ and the direction of the principal normal $\bar{e}_\rho$ of the trajectory can be calculated. These quantities uniquely determine the curve. For the nonrelativistic movement of an ion in any stationary electromagnetic field a computer code is suggested, which uses for each Runge-Kutta procedure a new position of a cylindrical coordinate system which is determined by ρ, $\bar{e}_\rho$, and the particle velocity $\bar{v}$. Higher accuracy for a given step number is to be expected. An expression for the radius of curvature of the projection of a trajectory on a stationary plane is derived which can be applied for graphical determination of ion trajectories. The curvature of an r-z movement trajectory in a rotationally symmetrical magnetic field is discussed. An investigation of simplified methods of calculation of electromagnetic forces is reported and resulting formulas given. The application of these calculations to DCX-2 is shown. Radial variation of forces on coils and the problem of forces on the injection snout are considered. A change in the mode of operation of the resistance network analog computer of the Engineering Science Group is described. The use of the device for determining magnetic field lines for a cusp geometry and for a DCX-EP-B "linear field" design are reported. Accessory electronics components for constant display of field lines are under construction. A design for a tubular injector for DCX-2 is presented, which is expected to give magnetic shielding for the injected beam without appreciably disturbing the main DCX-2 containment field outside. (auth)

24425 (PIBMRI-845-60) LEAKY WAVE CONTRIBUTIONS TO THE FIELD OF AN ELECTRIC LINE SOURCE ABOVE A PLASMA SLAB. T. Tamir (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Nov. 9, 1960. Contract AF19(604)-2031. 43p. (AFCRL-TN-60-1158; AD-252728)

As a further continuation of the investigations of leaky waves in dielectric slabs, the problem of a plasma slab, excited by a current line source, was analyzed. Since no surface waves were present in this case, the strength of the leaky waves was compared to the space field. The space wave field was evaluated and conditions for the existence of leaky waves were formulated; the locations of leaky wave poles were then determined and their contribution to the field was evaluated. It is shown that, for most cases, this contribution is not appreciable and, to first order of magnitude, the total field is given only by the space wave. However, for very thick slabs and for frequencies higher than the plasma frequency, the leaky waves may become predominant in certain specific directions and for some ranges in the vicinity of the source; on the other hand, the importance of such leaky waves seems to be restricted, due to the existence of a large number of contributing poles. (auth)

24426 (RADC-TN-61-4) ENERGY TRANSFER IN PLASMAS. Technical Note No. 7. (General Telephone and Electronics Labs. Inc., Palo Alto, Calif.). Nov. 15, 1960. Contract AF30(602)-2050. 34p. (AD-250181)

The diffusion of electrons in front of a shock wave results in a gradual rather than abrupt build-up of the electron density in front of the shock. This effect was studied in a shock tube by using a microwave interferometer at 18 kmc. With this interferometer it is possible to determine electron densities in the range from 7×10^{11} electrons/cm^3 to 3.5×10^{12} electrons/cm^3. The rise in density was found to be quite gradual, extending over a distance of approximately 15 cm for the above range. Theoretical results are presented for propagation in a plasma of non-uniform density. Numerical results are presented which give the absorption and reflection from a number of configurations in which the electron density increases linearly with distance. These indicate that one may expect absorption in the plasma of more than 30% of incident power for a case where the slab is only one free-space wavelength thick, and for ν/ω as low as 0.05. (auth)

24427 (RADC-TR-60-252) HEAT SHIELD RESPONSE OF AN IRRADIATED PLASMA. Report No. 8. Jean I. F. King and Edwin L. Gray (General Electric Co. Heavy Military Electronics Dept., Syracuse, N. Y.). Nov. 1960. Contract AF30(602)-1968. 21p. (AD-250182)

For certain ranges of plasma parameters it is possible to couple RF power instantaneously to a plasma with the resultant beam attenuation appearing as ohmic heating of the medium. If the irradiated plasma is thermally ionized, the medium will react to this additional heat source with an increase in electron density coincident with the heat input pattern. The new electron density distribution will in turn give rise to a new ohmic heating pattern. The heat flow equation was solved incrementally for a plane-parallel inhomogeneous plasma whose electron density increases exponentially in the direction of propagation of the incident RF beam. As expected on qualitative argument, the heating zone rapidly moved upstream exhibiting the self-shielding effect of the plasma. At the same time the beam reflection increased greatly as the electron density gradient was sharpened. (auth)

24428 (TID-13027) FREQUENCY CONVERSION IN A PLASMA. Technical Report No. 6. Jack R. Baird (Illi-

nois. Univ., Urbana. Electrical Engineering Research Lab.). May 1, 1961. Contract AT(11-1)-392. 56p.

It is known that under certain conditions a microwave gas discharge will radiate significant amounts of power at frequencies which are exact harmonics of the microwave frequency which generates the plasma. It appears that the source of the nonlinearity is not well understood in that no quantitative analysis of the nonlinearity was previously presented. A quantitative theoretical analysis of a microwave gas discharge is presented wherein the predominant source of nonlinearity is assumed to be a modulation of electron density. Qualitative arguments are presented to support the initial assumptions and to show that a modulation of electron density should be expected in certain types of discharges. Experimental verification of the theoretical analysis is presented in the form of frequency multiplication and frequency mixing experiments. (auth)

24429 (UCRL-6390) ENERGY BALANCE IN THE ASTRON DEVICE. Nicholas C. Christofilos (California. Univ., Levermore. Lawrence Radiation Lab.). June 15, 1961. Contract W-7405-eng-48. 39p.

For Presentation at IAEA Conference on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg, Austria, September 4-8, 1961.

The rate of thermonuclear energy release and the E-layer electron losses in the Astron Device are discussed. The reactor parameters necessary for optimizing the energy balance were derived and found to be more than adequate for heating the plasma up to ignition temperature. A discussion of the Astron program is presented. (D.L.C.)

24430 (ERD-TN-60-771) ON A CRITERION OF THE MAGNETOHYDRODYNAMIC EQUATIONS TO A PLASMA. S. I. Braginskii. Translated from Voprosy Magnit. Gidrodinamiki i Dinamiki Plazmy, Trudy Konf. Akad. Nauk Latv. S.S.R., Inst. Fiz. Riga, 67-71(1959). 5p. (AD-241738)

24431 (NP-tr-681) THE FIRST POLISH EXPERIMENTAL PLASMA ROCKET ENGINE. Andrezj Trepka. Translated for Air Technical Intelligence Center from Skrzydlata Polska, No. 31, 5-?(July 31, 1961). 7p.

The research program being conducted in Poland on plasma propulsion is described in an interview with Prof. Zbigniew Paczkowski. Outflow velocities of 7000 m/sec for Ar and 4400 m/sec for H have been attained for 100-v operation. The nature of plasma and the principles of plasma engine operation are discussed briefly. The possibilities of the plasma engine in the future are discussed. (D.L.C.)

24432 (TG-230-T161) OSCILLATIONS OF ELECTRON-ION PLASMAS. M. F. Shirokov and O. V. Prudkovskaya (Prudkovskaia). Translated by B. W. Kuvshinoff for Johns Hopkins Univ. from Nauch. Doklady Vysshei Shkoly, Fiz.-Mat. Nauki, No. 2, 192-9(1958). 11p.

A general system of equations of motion and electrodynamics is obtained for electron–ion plasmas. On the basis of this system, the existence of three basic types of plasma oscillations is shown. Equations for diffusion oscillations of electron–ion gas and for acoustic vibration of neutral gas are derived. (auth)

24433 CONCERNING CERTAIN COLLISIONLESS PLASMA-SHOCK WAVE MODELS. Peter D. Noerdlinger (Univ. of Chicago). Astrophys. J., 133: 1034-42(May 1961).

A shock-wave model proposed for the collision of two interstellar gas clouds or of the solar wind with the ionized gas around the earth is evaluated in the light of developments in plasma stability theory. It is shown that the instability that is supposed to arrest the counterstreaming of the ions and to transfer much of their kinetic energy to the electrons does not occur in many important examples. Specifically, instability is absent if the initial ion thermal energy exceeds 4.2×10^{-4} time their translational energy. While other plausible shock structures are known that yield suprathermal electrons, they depend on magnetic fields, leaving no satisfactory theory in the limit of zero magnetic field. (auth)

24434 ON THE AMPLIFICATION OF THE POLOIDAL MAGNETIC FLUX IN A PLASMA. L. Lindberg and C. Jacobsen (Royal Inst. of Tech., Stockholm). Astrophys. J., 133: 1043-8(May 1961).

An experiment is described by which a magnetized plasma is produced. The plasma has both a toroidal and a poloidal magnetic field. Under certain conditions the current system in the plasma becomes unstable, and part of the toroidal field is converted to a poloidal field. In this way the poloidal flux becomes amplified up to three to five times the original value. This phenomenon may be related to the mechanism by which the earth and other celestial bodies are magnetized. (auth)

24435 A COMPARISON OF TWO METHODS FOR MEASURING THE ELECTRICAL CONDUCTIVITY OF IONISED AIR IN A SHOCK-TUBE. Pierre Valentin (Commissariat à l'Énergie Atomique, Paris). Compt. rend., 252: 237-9(Jan. 9, 1961). (CEA-1915). (In French)

The electrical conductivities of air, ionized in a shock tube and measured by the magnetic method of Lin, Resler and Kantrowitz and by electrodes are compared. The agreement between these two methods is satisfactory. (auth)

24436 PLASMA ENGINEERING — PART I: GENERATING AND HEATING PLASMA. Michael F. Wolff. Electronics, 34, No. 28, 47-53(July 14, 1961).

A review of the methods and equipment necessary for generating and heating plasma are discussed. The techniques for supplying the energy to electrons in a gas that will produce the ionization required to form a plasma are both electromagnetic and nonelectromagnetic. The former include using a-c discharges, electromagnetic shock tubes, and electron beams, as well as d-c discharges that are primarily electrical. Nonelectromagnetic techniques include use of diaphragm shock tubes and contact ionization of cesium vapor. (N.W.R.)

24437 DELIVERING MEGAWATT R-F PULSES FOR RESONANT HEATING OF PLASMA. Homer M. Hill, Jr. (Princeton Univ., N. J.). Electronics, 34: No. 29, 70-3 (July 21, 1961).

Equipment designed and built for resonant heating on the B-66 Stellarator at Princeton is described. The pulsed r-f generator used operates over a frequency range of 16 to 24 Mc and can deliver over one Mw into a 50-ohm resistive load. Pulse duration may be varied from about 20 μsec to 15 msec by pulses from the Stellarator electronic timer. Circuit diagrams are given for the 6949 amplifier tube, network that adjusts for variable loading effect of plasma, and network that drives the commercial r-f power amplifier. Operating curves of the generator are also given. (N.W.R.)

24438 ELEMENTARY PROCESSES RELATED TO THE CATALYTIC ACTION OF μ^- FOR THE p-d FUSION REACTION. Yukio Mizuno (Tokyo Univ.). J. Phys. Soc. Japan, 16: 1043-56(June 1961). (In English)

The sequence μ^- (stopped) → $p\mu^-$ → $d\mu^-$ → $pd\mu^-$ → $He^3 + \mu^-$ is considered, in which the final μ has an energy of 5.3 Mev. A theoretical study is conducted of the $pd\mu$ and $pp\mu$

three-body problems; the pdμ and ppμ bound state properties; the reaction mechanisms; and the relation of the process $pd\mu \rightarrow He^3 + \gamma$ to the "mirror" reaction $n + d \rightarrow H^3 + \gamma$. The observed results are compared with theory, for both the molecular and nuclear processes. (T.F.H.)

24439 MOVING STRIATION IN MICROWAVE DISCHARGE PLASMA. Mikio Takeyama (Kyoto Univ.), Tanehiro Nakau, Sōzaburo Yamasaki, and Takeshi Isa. J. Phys. Soc. Japan, 16: 1255(June 1961). (In English)

A cylindrical plasma is described that is excited by a microwave oscillator operating in the TE 01 mode. Under certain conditions of geometry, and with the microwave E-field perpendicular to the plasma axis, a moving sonic wave is observed with a frequency of about 500 to 900 cps. The wave is not observed with the E-field parallel to the plasma axis. (T.F.H.)

24440 ABSORPTION AND REFLECTION SPECTRA OF AFTERGLOW PLASMA. Shigetoshi Tanaka (Kyoto Univ.). J. Phys. Soc. Japan, 16: 1259(June 1961). (In English)

The microwave absorption and reflection spectra in a cylindrical afterglow plasma are studied, for the cases in which the microwave E-field is perpendicular and parallel to the plasma axis. The plasma resonance, which occurs at $\sqrt{2}$ times the plasma frequency, is observed only when the E-field is perpendicular to the plasma axis. In addition, for both E-field alignments, several smaller resonances are observed at electron densities higher than the density at the plasma resonance. (T.F.H.)

24441 MICROWAVE MEASUREMENT OF FAST TIME VARYING PLASMAS. Susumu Takeda (Nagoya Univ., Japan). J. Phys. Soc. Japan, 16: 1267-8(June 1961). (In English)

The electron density, electron temperature, and collision frequency in a cylindrical afterglow plasma are measured as functions of time up to about 250 μsec. These values are deduced from microwave-detector measurements of the plasma impedance as a function of time. (T.F.H.)

24442 A METHOD FOR THE NUMERICAL CALCULATION OF HYDRODYNAMIC FLOW AND RADIATION DIFFUSION BY IMPLICIT DIFFERENCING. Carl A. Rouse (Univ. of California, Livermore). J. Soc. Ind. Appl. Math, 9: No. 1, 127-35(Mar. 1961). (UCRL-5476)

In the analysis of such phenomena as exploding wires, strong shocks, and the initial phases of blasts, a system is encountered in which there are coupled hydrodynamic flow and radiation diffusion. In order to take full advantage of implicit differencing techniques, with the very attractive feature that the stability conditions are independent of the time and space steps, a simple mathematical method for calculating both the hydrodynamic and radiation diffusion system implicitly is presented. (N.W.R.)

24443 ARC INITIATION ON HEATED METALS BY A HYDROGEN DISCHARGE. J. T. Maskrey, R. A. Dugdale, and R. C. McVickers (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 190: 997-8(June 10, 1961).

An investigation was made of the formation of unipolar and power arcs at metallic parts of a system exposed to plasma during experimental investigations of toroidal pinched discharges. Results of previous work indicated the important part played by insulating inclusions in metals in the process of arc initiation. Results are reported from a study of the arching characteristics of refractory metals, exposed to a toroidal discharge in pure hydrogen, as a function of temperature. Wires of commercial purity W, Ta, and Mo were used. The results support the hypothesis that arcs are initiated through the agency of second phases. Mechanisms which induce changes in arching characteristics are discussed. (C.H.)

24444 CONTROLLED THERMONUCLEAR FUSION MACHINES. Henri Baïssas (Centre d'Etudes Nucléaires, Fontenay-aux-Roses, France). Nucleus (France), No. 1, 31-41(Jan.-Feb. 1961). (In Paris)

The primary problems in controlled thermonuclear fusion are plasma heating and confinement. Many devices have been constructed in an effort to achieve these objectives. A review is given of the most significant of these instruments and of the advantages and faults of each. Rectilinear discharge, toroidal discharge, stellarator, ion injection, D.C.X., and OGRA are described. (J.S.R.)

24445 ON PLASMA OSCILLATIONS WITH SPECIAL EMPHASIS ON THE LANDAU DAMPING AND THE GROSS GAPS IN THE FREQUENCY SPECTRUM. A. Kildal (Univ. of Bergen). Nuovo cimento (10), 20: 104-22(Apr. 1, 1961). (In English)

A linear theory of oscillations of the form $\exp i(\mathbf{k} \cdot \mathbf{r} - \omega t)$ in a collision-free electron plasma in an external magnetic field H_0 is given. The theory is based on the equations of motion for each particle. Only the case $k \rightarrow 0$ is studied, and the singularities that appear are treated with the use of δ-functions. Expressions for the perturbation δv of the electron velocity are found. By a Taylor expansion in δv the perturbation of the distribution function is evaluated, and the density perturbation as well. The last quantity also satisfies the divergence equation. On elimination, a dispersion equation is obtained. In the case $k_{\parallel} H_0$, electrons with velocity equal to the phase velocity experience a constant electric field. Being thus accelerated, they deprive the field of its energy. This resonance absorption is calculated and the accompanying damping agrees with the Landau damping. The frequency gaps which appear in the case $k \cdot H_0 = 0$ are also studied. (auth)

24446 COLLECTIVE MOTIONS IN A PLASMA DUE TO MAGNETIC INTERACTION. G. Kalman (Israel Inst. of Tech., Haifa). Nuovo cimento (10), 20: 198-200(Apr. 1, 1961). (In English)

Static magnetic interactions between current elements in plasmas are investigated in the random phase approximation. It is shown that these interactions can bring about collective plasma motions. The plasma is assumed to have a singly lumped velocity distribution, which may be either Maxwellian or non-Maxwellian. Effects of electric forces are shown to be negligible. (T.F.H.)

24447 EQUILIBRIUM AMBIPOLAR POTENTIALS IN A MIRROR MACHINE. Richard F. Post (Univ. of California, Livermore). Phys. Fluids, 4: 902-5(July 1961).

A plasma confined in a mirror machine can be expected to develop an electrostatic potential with respect to its surroundings. This potential arises because of the intrinsically different rate of diffusion in velocity space of the electrons and ions. When the temperature of the confined electrons is comparable to or smaller than the ion temperature, the potential will be positive, and will vary within the plasma. The variation of plasma potential with position in a mirror machine is calculated for conditions where: (a) the electron temperature is small compared to ion temperature and (b) electrons and ions are separately in diffusion equilibrium with the mirror losses. It is shown in an example that the plasma potential tends to concentrate near the mirrors, and that its variation, between the mirrors, is relatively insensitive to the total potential. Applications and extensions of the calculations are suggested. (auth)

24448 INJECTION AND TRAPPING OF A $\beta = 1$ PLASMA INTO A CUSPED MAGNETIC FIELD. D. C. Hagerman and J. E. Osher (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 4: 905-11(July 1961).

An experiment using a plasma gun as a source to inject a high-velocity jet of plasma into a picket fence magnetic confinement system is described. The results show that a plasma jet having 5×10^{13} deuterons/cm^3 and a mean directed kinetic energy of 1 kev/deuteron is able to traverse a 2-kgauss magnetic barrier displacing the field completely in its path, i.e., traveling as a $\beta = 1$ plasma. Some focusing of the plasma jet occurs during the penetration which increases its density. If the plasma is injected into a higher field it mixes with the field and penetrates as a $\beta < 1$ plasma. These two phenomena combine so that the idealized sudden stopping of a given beam at a critical magnetic field ($B_c^2 > 12\pi\rho V^2$) is not observed. For fields <2000 gauss the plasma jet opens the entrance cusp for ≈ 3 μsec; a biconical diamagnetic region with $\beta = 1$ builds up within the picket fence volume and then decays with a time constant of 50 μsec. This indicates that some irreversible process does occur, trapping plasma within the magnetic confining field. (auth)

24449 ASYMMETRIC COLLAPSE ACCELERATORS FOR COUNTER-HELMHOLTZ GEOMETRIES WITH INTERNAL INJECTION. Ralph W. Waniek (Advanced Kinetics, Inc., Costa Mesa, Calif.), Heinz Fischer, and Sang W. Lee. Phys. Fluids, 4: 928-30(July 1961).

Plasma is generated inside a counter-Helmholtz geometry in a hydrogen atmosphere at 100-μ pressure and under a 96-Mc preionizing field. Two plasma structures undergo interaction in the field-free region of the counter-Helmholtz geometry. Signals are measured. It appears that the colliding dipoles repel with partial interpenetration increasing with time. It seems that oscillations of contrastreaming plasmas may be generated by means of such counter-Helmholtz geometry with internal injection. (L.N.N.)

24450 SPACE DISPERSIVE PROPERTIES OF PLASMA. Jacob Neufeld (Oak Ridge National Lab., Tenn.). Phys. Rev., 123: 1-10(July 1, 1961).

The "space dispersion," i.e., the occurrence of the term k in the dielectric constant $\epsilon(\omega,k)$ can be attributed either to the Doppler effect or to the magnitude of the term ak that may appear in the formulation of the problem. a is a characteristic distance such as the Debye length. Using an approach based on the Doppler effect, the macroscopic parameters of a plasma are represented in the form of four-dimensional tensors of the fourth order. The phenomenological description of plasma is also formulated in a three-dimensional space by means of two macroscopic parameters: the electric susceptibility χ_e and the proper magnetic susceptibility χ_μ/μ. Expressions for these parameters are given for the general case of a plasma having an electron velocity distribution $f(v)dv$ and for typical specific cases. Both parameters are functions of the frequency and of the wave vector. This formulation brings into evidence the fact that a plasma is a magnetically polarizable medium and the term χ_μ/μ vanishes only if the electron velocity distribution is isotropic. A general formalism is developed for deriving the electric and magnetic plasma parameters directly from the Boltzmann-Vlasov equations. (auth)

24451 THEORY OF THE SLOW PINCH DISCHARGE. I. MAGNETOHYDRODYNAMIC STABILITY OF THE DISCHARGE CORE. A. A. Ware (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Phys. Rev., 123: 19-24 (July 1, 1961). (GA-1937)

Among the unexplained properties of the slow pinch discharge observed in Zeta, Sceptre, and other experiments is the gross magnetohydrodynamic stability of the discharge. Since the pinch of the magnetic lines of force is approximately constant within the main core of these discharges, the energy principle is applied to such a configuration. The stability condition for interchange modes is studied. For kink modes, dp/dr should be greater than some undetermined positive quantity. Comparison with experimental results suggests that interchange instabilities occur and limit the negative pressure gradient, whereas the kink modes can occur with, at most, only small amplitude. Possible reasons are given to explain why the kink instability is not observed. (auth)

24452 LIFETIMES OF FAST IONS IN THE PLASMA OF DCX. C. F. Barnett, J. L. Dunlap, R. S. Edwards, G. R. Haste, H. Postma, J. A. Ray, R. G. Reinhardt, W. J. Schill, R. M. Warner, and E. R. Wells (Oak Ridge National Lab., Tenn.). Phys. Rev. Letters, 6: 589-91(June 1, 1961).

Results of an experiment on DCX are reported. A beam of H^{2+} (or He^+) is injected into the mirror machine, and is dissociated by collisions with residual gas molecules. The lifetimes of protons and He^+ ions in the plasma are measured at 10^{-7} to 10^{-5} mm Hg plasma pressure. Evidence is presented that charge exchange is the dominant loss mechanism. Proton and He^+ ion lifetimes on the order of seconds may be obtained, at plasma densities of about 10^7 particles/cm^3. (T.F.H.)

24453 GROUND-STATE ENERGY OF AN ELECTRON GAS IN A LATTICE OF POSITIVE POINT CHARGES. A. Bellemans and M. De Leener (Université, Brussels). Phys. Rev. Letters, 6: 603-4(June 1, 1961).

The ground state energy ϵ of an electron gas in a rigid lattice of positive point charges is calculated as a function of the Bohr radius between electrons, by quantum statistical methods. The couplings between pairs of electrons, and between electrons and lattice points, are taken into account. The value of ϵ in a positive continuum is derived as a special case. As an example, ϵ is calculated for an H lattice. (T.F.H.)

24454 CHARACTERISTIC FUNCTIONAL FOR PLASMA TURBULENCE. Keniti Goto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 25: 603-12(Apr. 1961).

A functional analytical description of magnetohydrodynamic turbulence in an incompressible plasma flow is investigated by a method derived for an ordinary hydrodynamic turbulence. An exact stationary solution of the functional differential equation for the characteristic functional is given for the special case of an inviscid and infinitely conducting plasma. This solution shows the equipartition of the kinetic and magnetic energies. A formal general solution is also obtained by assuming the possibility of the functional Fourier transformation. (auth)

24455 CONFINED PLASMA ELLIPSOID. A. Ya. Voronov. Vestnik Moskov. Univ. Ser. III. Fiz., Astron., No. 5: 74-80(Sept.-Oct. 1960). (In Russian)

The equilibrium and stability of the spatially confined charged plasma are analyzed using an incompressible homogeneous liquid uniformly charged by positive electricity. The equilibrium and stability conditions of a rotating ellipsoid of the liquid were determined in hydrodynamic approximation. (R.V.J.)

24456 MAGNETIC END CLOSURES FOR CONTROLLED FUSION REACTORS. (to U. S. Atomic Energy Commission). British Patent 873,057. July 19, 1961.

A multiple reflector field closure for containing charged particles and used for controlling an open-ended thermonuclear reactor is described. The device is provided with

magnetic field generating means for generating an axially symmetrical magnetic field in the central region of the device and plasma source means are disposed to establish a plasma radially restrained by the field in the center region of the device. Coaxial solenoid means are located at or adjacent opposite ends of the device, each of which solenoid means is arranged to produce, when energized, a number of axially spaced reflector field regions of increased magnetic intensity at the ends of the field in the central region of the device thereby defining trapping cell regions of reduced magnetic intensity between adjacent reflector field regions such that axial losses of charged particles from the central region of the device are reduced to a minimum by the regions. (N.W.R.)

Shielding

24457 (AD-250640) ANALYSIS OF THE CRITICAL SHIELDING VOLUME FOR UNDERGROUND SHELTERS. J. C. Ledoux (Naval Civil Engineering Lab., Port Hueneme, Calif.). [nd]. 30p.

The development of design principles for constructing atomic warfare shelters for naval shore establishments is described. An investigation was made to determine which part of the earth covering a buried shelter is the most important as a radiation shield. The equation $(1-F)\ E_1(u_i x) = E_1(u_i \times \sec\theta)$, when solved for the critical angle, θ, will define the volume of earth which provides the fraction, F, of the total shielding to the shelter system. E is the exponential integral, u_i is the effective linear absorption coefficient for the shielded material, and x is the effective shield thickness. Computations were completed for slab and hemisphere geometry for fractions, F, of 0.99 and 0.999. For slab geometry, x was equivalent to t_m, the thickness of the slab shield. For hemispherical geometry, x was equivalent to R_m which was the sum of the radius of the hemisphere plus the minimum cover over the arc. In order to preserve the shielding integrity of the shelter system, the shielding volume defined by θ should not be violated by openings of any sort. (auth)

24458 (ERDL-1622-TR) A STUDY OF THE ENGINEERING ASPECTS OF EXPEDIENT GAMMA-SHIELDING MATERIALS. Cluey D. Hargrove and Allen F. Grum (Army Engineer Research and Development Labs., Fort Belvoir, Va.). Apr. 7, 1960. 72p. (AD-238440)

Tests were made to determine attenuation coefficients and dose rates as a function of shield thickness for the following shielding materials: water, limestone, sandstone, granite, sand, clay, silt, organic top soil (loam), fir, and oak. The following gamma emitters were used: Hg^{203}, Cs^{137}, Rb^{86}, Pr^{142}, and Na^{24}. Measurements were made with a NaI (Tl) crystal and a 128-channel pulse height analyzer. Point sources were used for the attenuation coefficient measurements and 12-in. diameter uniformly distributed sources for the dose rate measurements. Attenuation coefficients were plotted as a function of energy for the various materials. Dose rates are plotted as a function of shield thickness and gamma energy for the various shield conditions. (auth)

24459 (NAA-SR-4542) INVESTIGATIONS OF NEUTRON PENETRATION IN TiH AND STEEL SLABS. R. H. Karcher (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 15, 1961. Contract AT(11-1)-GEN-8. 38p.

A multigroup P_1 approximation for hydrogen scattered neutrons was developed and applied to the study of neutron flux distributions in titanium hydride and steel shield systems. Experimental data for systems of this type were measured at the Atomics International AE-6 water boiler reactor facility. Comparison of the theoretical and experimental results reveals some disagreement, and a plausible explanation for this disagreement is discussed. It is concluded that the multigroup P_1 model, within certain limits of accuracy, may be relied upon in the neutron shielding application for titanium hydride. Recommendations are submitted for improving both the quality of the experimental data and the rigor of the theoretical analysis. (auth)

24460 (USNRDL-TR-514) SHIP SHIELDING FACTORS—COMPUTATIONAL METHOD COMPARED TO EXPERIMENTAL RESULTS. L. G. Haggmark (Naval Radiological Defense Lab., San Francisco). June 7, 1961. 24p.

A previously developed computational method was used to obtain the ratios of the gamma-radiation dose rates at given interior points of a light aircraft carrier to the dose rate 3.5 feet above the center of the Flight Deck which was assumed to be covered uniformly with Co^{60}. The results of the computations were compared with values determined by an experiment on the ship where the Flight Deck was uniformly contaminated with Co^{60}. The comparison was made for two portions of the ship which have different structural components. The results of the comparison showed the computed values to be higher than the experimental values and generally within 28% in the relatively "open" portion of the ship and generally worse than 50% in the more heavily compartmentalized portion of the ship. (auth)

24461 TRANSMISSION OF SCATTERED γ-RAYS THROUGH CONCRETE AND IRON SLABS. D. J. Raso (Technical Operations Inc., Burlington, Mass.). Health Phys., 5: 126-41(June 1961).

The penetration of γ rays undergoing one or more scatterings in concrete and iron of various slab thicknesses (3.75 to 60.0 g/cm^2) was investigated by the Monte Carlo technique. Radiation with energy of 350, 660, and 1250 kev and also the γ spectra produced by the products (omitting volatile materials) of U^{235} fission at 1.12 and 23.8 hr after fission were assumed to be incident on the medium at angles of $\cos\theta_0 = 0, 0.25, 0.50, 0.75$, and 1.0. The case histories of 5000 photons were followed on the IBM 704 digital computer. The information obtained included: number and energy transmitted, the energy distribution of the transmitted radiation integrated over all directions, the angular distribution integrated over all energies, and the angular distribution of the transmitted energy and transmitted "dose." These computed quantities refer to transmitted current, and an approximation is given for determining flux density. Comparisons are made with other theories and an experiment performed at USNRDL. (auth)

Theoretical Physics

24462 (AFOSR-773) LECTURES ON THE USE OF PERTURBATION METHODS IN DISPERSION THEORY. Physics Department Technical Report No. 211. Richard J. Eden (Maryland. Univ., College Park). Apr. 12, 1961. Contract AF 49(638)-24. 127p.

The use of perturbation methods in the dispersion theory is discussed. The mathematical development of analyticity properties in the perturbation theory is outlined. Topics covered include analytic structure in elementary particle physics, mathematical methods for the study of singularities of amplitudes in perturbation theory, functions of two complex variables, singularities of the general fourth order amplitude, the Mandelstam representation for a general

term in the perturbation theory, anodes and cusps on Landau curves, production amplitudes, and unitarity. (M.C.G.)

24463 (CERN-61-14) CONTINUOUS GEOMETRY AND SUPERSELECTION RULES. J. M. Jauch (European Organization for Nuclear Research, Geneva). Apr. 17, 1961. 27p.

Results of research on the theory of operator rings in a Hilbert space are presented on an intermediate level of sophistication. Applications of this theory to problems in quantun mechanics are also discussed. In development of theoretical physics it is possible to distinguish structural properties of physical systems which have nothing to do with dynamical properties of the system. The physical meaning of these structural varieties is investigated. (J.R.D.)

24464 FIELD-THEORETIC APPROACH TO THE PROPERTIES OF THE SOLID STATE. Gordon Baym (Harvard Univ., Cambridge, Mass.). Ann. Phys. (N. Y.), 14: 1-42(July 1961).

The techniques of quantum field theory are used to investigate the thermodynamic ion displacement correlation function—or Green's function of the phonon field—in a crystal and especially in a metal. The structure of thermodynamic Green's functions is outlined and the method for solving for them at finite temperature is fully discussed. The analytic structure of the phonon Green's function is then considered. This function is shown to be bounded and invertible everywhere off the real axis; a spectral form is derived for its inverse. The symmetries imposed by the point group of the crystal are then discussed. Assuming small ionic oscillations, we find the inverse of the phonon Green's function as a linear function of the electronic contribution to the dielectric response function of the metal. This dielectric function is shown to be simply related to the longitudinal part of the conductivity tensor that gives the response of the electrons to the effective electric field in the metal. The assumption of translational invariance then leads to an explicit expression for the phonon Green's function in terms of this conductivity. The deformations in the lattice induced by an arbitrarily time varying external force are calculated in terms of the retarded phonon Green's function. In the static long wavelength limit the phonon Green's function yields the macroscopic elastic constants of the crystal. Their relation to the conductivity is exhibited, and several elastic constants are estimated. We also see that the complete phonon spectrum and the lifetimes of the phonon states may be calculated from this Green's function. A relation between the long wavelength acoustic attenuation in metals and the dc conductivity is derived, which is in good agreement with recent experiments. Furthermore, the ions in a metal are shown to have a high-frequency oscillation along with the electrons, at essentially the electron plasma frequency. (auth)

24465 COMPARISON OF TWO MODELS FOR THE MANY-FERMION SYSTEM. E. M. Henley and L. Wilets (Univ. of Washington, Seattle). Ann. Phys. (N.Y.), 14: 120-42(July 1961).

A critical comparison is given between the Overhauser model (Phys. Rev. Letters 4, 415(1960)) and the model of Bardeen et. al. (Phys. Rev. 108, 1175(1957)). Firstly, a comparison is made for a separable two-body interaction which is constant over a thin shell straddling the Fermi surface in one, two, or three dimensions. Secondly, the comparison is carried out for a one-dimensional, non-separable, Gaussian potential. Finally, a BCS-type model is investigated in which time-reversed Overhauser waves, rather than plane waves, are paired. (L.T.W.)

24466 THE EXPONENTIAL DECAY LAW OF UNSTABLE SYSTEMS. Roger G. Newton (Indiana Univ., Bloomington). Ann. Phys. (N. Y.), 14: 333-45(July 1961).

It is shown that associated with any sufficiently sharp resonance there is a delayed emergence of particles that under suitable conditions follows an exponential law of decay to an excellent approximation over many lifetimes. The dependence of the duration of the exponential curve on the resonance width, on the excitation width, and on the observation distance is examined in detail. (auth)

24467 ON GEOMETRODYNAMICS AND NULL FIELDS. Asher Peres (Israel Inst. of Tech., Haifa). Ann. Phys. (N. Y.), 14: 419-39(July 1961).

The possibility of describing null electromagnetic fields by purely metric concepts has recently been subject to some doubt. Following a method devised by Hlavatý, the relations that a Riemannian manifold must satisfy in order to correspond to a null electromagnetic field are investigated. It is shown that in most cases the fulfillment of five geometrical relations is a necessary and sufficient condition for the existence of a null electromagnetic field. The latter is unique, except for an arbitrary constant phase factor (as in the case of non-null fields). However, in some exceptional cases, there is a larger degree of arbitrariness in the null electromagnetic field that corresponds to a given metric. Such fields (which always possess wave fronts) are not reducible to metric concepts. The problem of how it can occur that null electromagnetic fields require the fulfillment of five relations, rather than three, as non-null ones is investigated. In order to settle this question, an attempt was made to consider null fields as a limiting case of non-null ones, by superimposing an arbitrary infinitesimal non-null field on a finite null one. It is then shown that the Rainich vector of such a field does not have a well defined limit, when the perturbing non-null field tends to zero. It is thereby inferred that null electromagnetic fields really have a special status within the frame of geometrodynamics. (auth)

24468 STRICT LOCALIZATION IN QUANTUM FIELD THEORY. James M. Knight (University of Maryland, College Park). J Math. Phys., 2: 459-71(July-Aug. 1961).

A definition of strict localization of states in quantum field theory is presented. This definition is based on considering products of field operators as the primary measurable quantities of the theory. An example of a localized state is given, showing that such a state arises when a free field interacts with an external current that is limited to a bounded region of space-time. It is shown by means of a graphical technique that a state having a finite number of particles cannot satisfy the definition of localization. A simple representation of localized states is investigated, and arguments are given to support its generality and uniqueness. (auth)

24469 ON THE INTERPRETATION OF THE EINSTEIN-SCHRÖDINGER UNIFIED FIELD THEORY. D. W. Sciama (Cornell Univ., Ithaca, N. Y.). J. Math. Phys., 2: 472-7 (July-Aug. 1961).

Vierbeins are used to analyze the Einstein-Schroedinger unified field theory, in both its real nonsymmetric and complex Hermitian versions. It appears that the skew-symmetric part of the real affine connection is related to spin rather than to electromagnetism. In its complex form the theory does appear to describe the electromagnetic field, since the vierbein analysis shows that gauge transformations arise in a natural way (the spin is then related to the skew-Hermitian part of the affine connection). The resulting identification of the electromagnetic field tensor

implies that Einstein's choice of Lagrangian is physically unsatisfactory and an alternative Lagrangian is proposed. Although the electromagnetic field is thus geometrized, neither Lagrangian represents a unification of electromagnetism and gravitation. (auth)

24470 CHARACTERISTIC COULOMB GREEN'S FUNCTION AND ITS EIGENFUNCTION EXPANSION. Robert A. Mapleton (Air Force Cambridge Research Labs., Bedford, Mass.). J. Math. Phys., 2: 478-82(July-Aug. 1961).

The eigenfunction form of the Green's function is derived from the characteristic form of the Green's function for the nonrelativistic Coulomb operator. This derivation shows how the wave boundary condition of the characteristic form of the Green's function is related to the branch cut in the continuous part of the spectrum. An application of the eigenfunction expansion form of this Green's function is discussed. (auth)

24471 APPLICATION OF A SINGULAR WAVE-FUNCTION OPERATOR IN SCATTERING THEORY. Robert A. Mapleton (Air Research and Development Command, Bedford, Mass.). J. Math. Phys., 2: 482-90(July-Aug. 1961).

A function which is defined in terms of the two-body singular wave-function matrix of Møller acting on a plane-wave state is calculated. It is found that the function has a normalization which is different from the one assumed by Pradhan, and this behavior is attributed to the long-range character of the Coulomb potential that is in the Møller operator. An intermediate result agrees with the momentum-space solution of the nonrelativistic Coulomb two-body scattering problem which recently appeared in a paper published by S. Okubo and D. Feldman. As they show, the wave function must be renormalized to obtain the correct cross section, and this view is adopted in this paper. Consequently, the normalization assumed by Pradhan is reinstated. The Legendre expansion coefficients are calculated for the function, $(a-b\cos\theta)^{-c}$. (auth)

24472 MODIFICATION OF EFFECTIVE-RANGE THEORY IN THE PRESENCE OF A LONG-RANGE (r^{-4}) POTENTIAL. Thomas F. O'Malley, Larry Spruch, and Leonard Rosenberg (New York Univ., New York). J. Math. Phys., 2: 491-8(July-Aug. 1961).

For short range potentials, there exists the effective-range theory expansion $k^{2L+1}\cot\eta(L) = -1/A(L) + \frac{1}{2}r_0(L)k^2 + \cdots$, where $\eta(L)$ is the phase shift for angular momentum L. For long-range potentials (potentials which vanish at large r only as some power of 1/r) an expansion in k^2 does not exist. For $V(r) \to \text{const} \times r^{-n}$ for $r \to \infty$, the term at which the expansion breaks down depends upon L and upon n; A(L) cannot be defined if $n \leq 2L + 3$, while for example for $L = 0$ one cannot define r_0 in the usual way if $n \leq 5$. A detailed study is made of the case $n = 4$. This case is of considerable interest since it arises, in the adiabatic approximation, in the scattering of a charged particle by a neutral polarizable system; the present analysis is concerned with the scattering by a static potential, but it can be readily generalized to include scattering by a compound (polarizable) system. The analysis is very much simplified by the existence of known mathematical solutions, Mathieu functions, of the Schrödinger equation with V(r) equal to $\text{const} \times r^{-4}$. The expansion of $k\cot\eta(0)$ about $E = 0$ contains a number of terms not present in the usual effective-range theory, including a term linear in k. The expansion about the energy of a weakly bound state does not contain these additional terms. It is rather of the usual form, but the correction will be of lower order than k^4. The leading terms in the expansion of $k^2\cot\eta(L)$ for $L \neq 0$ are also obtained. (auth)

24473 MULTIPLE SCATTERING OF WAVES. P. C. Waterman (Avco Corp., Wilmington, Mass.) and Rohn Truell. J. Math. Phys., 2: 512-37(July-Aug. 1961).

Multiple scattering effects due to a random array of obstacles are considered. Employing a "configurational averaging" procedure, a criterion is obtained for the validity of approximate integral equations describing the various field quantities of interest. The extinction theorem is obtained and shown to give rise to the forward-amplitude theorem of multiple scattering. In the limit of vanishing correlations in position, the complex propagation constant k of the scattering medium is obtained. Under appropriate restrictions, the expression for k is shown to include both the square-root law of isotropic scatterers and the additive rule for cross sections valid for sufficiently low densities of anisotropic obstacles. Some specific examples from acoustics and electromagnetic theory then indicate that at least in the simplest cases the results remain for physically allowable densities of obstacles. (auth)

24474 EXACT WAVE FUNCTIONS IN SUPERCONDUCTIVITY. Daniel Mattis and Elliott Lieb (IBM Research Center, Yorktown Heights, N. Y.). J. Math. Phys., 2: 602-9(July-Aug. 1961).

The ground-state wave function and some of the excited states of the BCS reduced Hamiltonian are found. In the limit of large volume, the boundary and continuity conditions on the exact wave function lead directly to the equations which Bardeen, Cooper, and Schrieffer found by a variational technique. It is also shown in what sense the BCS trial wave function may be considered asymptotically exact in this limit. Finite-volume corrections are included in an appendix, and explicit calculations are carried out for a one-step model of the kinetic energy which has possible applications to the problem of the finite nucleus. (auth)

24475 ON THE ENERGY-MOMENTUM TENSOR OF THE GRAVITIONAL [GRAVITATIONAL] FIELD. F. R. Tangherlini (Scuola di Perfezionamento in Fisica Teorica e Nucleare, Naples). Nuovo cimento (10), 20: 1-19(Apr. 1, 1961). (In English)

It is suggested that the cosmological term $\kappa^{-1}Ag_{\mu\nu}$, with $A > 0$, fulfills the basic requirements of a generally covariant energy-momentum tensor for the gravitational field. Justification is given for this hypothesis by studying the character of the field equations in the absence of the cosmological term; by a re-interpretation of the line element based on Mach's principle; and by calculating the gravitational proper energy for a de Sitter static universe with and without a Schwarzschild field present, showing that the difference is proportional to the Schwarzschild mass. Finally an attempt is made to define a true tensor for the angular momentum density. It is shown that this line of reasoning leads to a definition of "physical coordinates." These coordinates are determined in such a way that in the weak-field limit they approach the usual Lorentz coordinates. However, it is not possible to arrive at these coordinates by imposing coordinate conditions, since they form the components of a vector. To the extent that the angular momentum of the gravitational field is covariantly conserved, the coordinates may be obtained as the gradient of a world scalar that satisfies an inhomogeneous d'Alembertian equation. (auth)

24476 LOW ENERGY LIMIT OF COMPTON SCATTERING WITHOUT T, C, P INVARIANCE. E. Kazes (Pennsyl-

vania State Univ., University Park). Nuovo cimento (10), 20: 20-7(Apr. 1, 1961). (In English)

When only TCP invariance is valid, Compton scattering from a spin—½ particle is shown to be entirely determined by its mass, charge, and magnetic and electric dipole moment in the two lowest orders of the frequency. (auth)

24477 CLASSICAL GAUGE INVARIANCE OF ELECTRODYNAMIC QUANTITIES. B. Jouvet (Collège de France, Paris). Nuovo cimento (10), 20: 28-58(Apr. 1, 1961). (In French)

The principles of gauge invariance are recalled, and their violations occurring in perturbation theory are studied, e.g., the photon self-energy, and the photon-photon interaction term. A new equation is developed for the photon field, involving new renormalization constants, such that the S-matrix is gauge invariant, without using regularization. Gauge invariance of the field equations supplies relations for the new renormalization constants. Non-perturbative calculations prove the consistency of these relations and connect the new constants to the observable quantities. The values of these constants are then calculated to every order of perturbation theory. (auth)

24478 PROPAGATORS OF A SELF-COUPLED SPINOR FIELD IN EDWARDS AND LIEB'S APPROXIMATION. G. Pócsik (Roland Eötvös Univ., Budapest). Nuovo cimento (10), 20: 201-4(Apr. 1, 1961). (In English)

The one- and two-body propagators of the scalar Fermi self-coupling are investigated by using their continuous integral representations. The Edwards-Lieb nonperturbative method is used to find the propagators in the first approximation. The existence of ghost states in this method is discussed. (T.F.H.)

24479 THE ENERGY PARAMETER IN THE DISPERSION RELATION. G. Mohan (National Physical Lab., New Delhi, India). Nuovo cimento (10), 20: 205-7(Apr. 1, 1961). (In English)

Kinematical parameters are obtained for the single variable dispersion relation, in the case in which all four of the particle masses involved in a two-particle collision (i.e., the incoming, target, outgoing, and residual particles) are different. A modified frame of reference is produced by a Lorentz transformation of the Breit frame of reference. The parameters that are found are shown to reduce to the Breit parameters at nonrelativistic energies. (T.F.H.)

24480 CONDITIONS FOR BOUND STATES WITH A GIVEN SET OF INTERACTION POLES IN CHEW-MANDELSTAM THEORY. M. Fowler (St. John's Coll., Cambridge, Eng.). Nuovo cimento (10), 20: 478-86(May 1, 1961). (In English)

Using the potential model with the left-hand cut approximated by n poles, conditions are derived under which no extra "bound state" poles need be introduced. The procedure adopted comprises finding the domain in n-space covered by the sets of values of residues in which no extra poles need be introduced. It is shown that any point in this domain can be reached by adjusting only n poles on the unphysical sheet. (auth)

24481 SOME PROPERTIES OF THE PROPAGATORS OF A SCALAR FIELD INTERACTING WITH HIMSELF. A. Visconti (Faculte des Sciences, Marseille). Nuovo cimento (10), 20: 596-8(May 1, 1961). (In English)

A self-interacting scalar field is considered. The properties of the generating functional of this field's propagators are studied. It is shown that the generating functional may be represented as a product of separable kinematic and dynamic parts. The properties of these parts are examined in local and non-local field theories. (T.F.H.)

24482 ELECTROMAGNETIC PARAMETERS OF MATTER AND CONDITIONS FOR PHYSICAL REALIZABILITY. G. Gerosa (Università, Rome), G. Latmiral, and R. Vinciguerra. Nuovo cimento (10), 20: 610-16(May 16, 1961). (In English)

The conditions are examined which a complex function of a real variable must satisfy in order that it may be considered as the frequency response of a linear system. The cases of the physical realizability and of the stability of the system are considered and use is made of the Hilbert transforms. The relations existing between the real and the imaginary part of the e.m. parameters of matter are studied by means of the Hilbert transforms, also known as Kramers-Krönig equations. The case of imperfect dielectrics is particularly examined, and a suitably modified form of K.-K. equations is presented. The above considerations are extended to the anisotropic media; special reference is made to the susceptivity of magnetized ferrites. When losses are present, and the parameters of the tensor are consequently finite for any frequency, the parameters must comply with Kramers-Krönig equations. This is actually the case for the expressions which are generally used. (auth)

24483 ON THE PHYSICAL INTERPRETATION OF COMPLEX POLES OF THE S-MATRIX. [PART] II. H. M. Nussenzveig (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Nuovo cimento (10), 20: 694-714(May 16, 1961). (In English)

The initial-value problem for a Schroedinger particle interacting with a partially transparent sphere (δ-function potential) is solved. The general solution is expanded in terms of the propagators of transient modes. The relation between this expansion and the stationary-state expansion for an impenetrable sphere is discussed. Two special cases are considered: the decay of a wave packet initially confined within the sphere and the scattering of a wave packet by the sphere in the case of a sharp resonance. In the decay problem, the domain of validity of the exponential law and the deviations from this law are investigated. In the resonance scattering problem, the behavior of the solution in the internal and external regions as a function of the width of the excitation is discussed. The concept of time delay at resonance is analyzed. (auth)

24484 UNITARITY AND THE MANDELSTAM REPRESENTATION. [PART] II. R. W. Lardner (St. John's Coll., Cambridge, Eng.). Nuovo cimento (10), 20: 733-46(May 16, 1961). (In English)

An earlier investigation into the analyticity of the three-particle unitarity contribution to a scattering absorptive part is discussed more completely. The general term is shown to reduce to the same form as the three-particle term. (auth)

24485 TRANSFORMATIONS OF RELATIVISTIC TWO-PARTICLE EQUATIONS. E. Eriksen (Univ. of Oslo). Nuovo cimento (10), 20: 747-58(May 16, 1961). (In English)

It is shown that relativistic two-particle equations like the Breit equation and the Hermitian part of the three-dimensional Bethe-Salpeter equation, in the c.m. system can be transformed to new canonical forms which are generalizations of the Foldy-Wouthuysen-Tani representation and the Cini-Touschek representation, respectively. The expansion of the transformed Hamiltonian is in powers of the inverse momentum. In the case of particles with equal masses also an expansion in powers of the electric charge is made. (auth)

24486 CORRELATION THEORY OF STATIONARY ELECTROMAGNETIC FIELDS. PART III. THE PRESENCE OF RANDOM SOURCES. P. Roman (Boston Univ.).

Nuovo cimento (10), 20: 759-72(May 16, 1961). (In English)

The previously developed correlation theory of stationary random electromagnetic fields is extended to the case in which the fields interact with stationary random charges and currents. The basic field equations are deduced and are found to be second order partial differential equations. An analog to the equation of continuity is derived and some illustrative examples are discussed. Wave equations, which are of the fourth order, are deduced for the electric and magnetic correlation tensors. The theory presented may have various applications for the theory of plasmas. (auth)

24487 SOLUTION OF THE EQUATIONS FOR THE GREEN'S FUNCTIONS OF A TWO DIMENSIONAL RELATIVISTIC FIELD THEORY. K. Johnson (Massachusetts Inst. of Tech., Cambridge). Nuovo cimento (10), 20: 773-90(May 16, 1961). (In English)

The explicit solution of the coupled set of equations for the Green's functions for the self-coupled field theory model of Thirring is given. It is found that the infrared problem causes no special difficulty. The question of how to define products of singular field operators at coincident space-time points arises and it is shown that the commutation relations for such products are not consistently given by making use of the formal expressions and the canonical commutation relations. The problem of gauge invariance in an external field is studied and it is shown that: (a) the current and charge density do not commute at equal times, and (b) this is necessary for and consistent with the gauge invariance of the field equations. (auth)

24488 SOME REMARKS ON HIGH-ENERGY INELASTIC COLLISIONS WITH SMALL MOMENTUM TRANSFER. P. Beckmann (Institut für Theoretische Physik, Heidelberg, Ger.). Nuovo cimento (10), 20: 812-13(May 16, 1961). (In English)

Inelastic processes with small momentum transfer are often considered to receive their dominant contribution from graphs corresponding to the exchange of a low mass state between the target and the beam particle. Conditions under which this is not true are considered. (L.T.W.)

24489 DEBYE-WALLER FACTOR IN MÖSSBAUER INTERFERENCE EXPERIMENTS. H. J. Lipkin (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev., 123: 62-3 (July 1, 1961).

A simple calculation is presented for the effects of lattice dynamics on interference between Mössbauer processes and corresponding atomic processes, for instance between Mössbauer and Rayleigh scattering, or between internal conversion of Mössbauer radiation and the photoelectric effect. When the energy of the emitted γ ray or electron is not measured, it is necessary to sum over all possible final states of the lattice. The interference contribution is found to be attenuated by the same "Debye-Waller" factor as the ordinary Mössbauer contribution, depending only upon the momentum of the incident γ ray. If the energy of the emitted γ ray is measured (e.g., by a Bragg scattering experiment), the atomic contribution is attenuated by the usual x ray Debye-Waller factor, depending upon the momentum transfer; the Mössbauer contribution is attenuated by the square of the usual Mössbauer factor, and the interference term is attenuated by the geometric mean of the atomic and Mössbauer factors. (auth)

24490 LAGRANGIAN FORMALISM IN RELATIVISTIC DYNAMICS. G. Kalman (Israel Inst. of Tech., Haifa). Phys. Rev., 123: 384-90(July 1, 1961).

A covariant Lagrangian formalism is put forward, which has an explicit variation of the proper time in the action functional. This approach conforms with the geometrical interpretation in space-time. A general equation of motion is derived, which is not identical with the Euler-Lagrange equation. Momentum and mass are unambigously defined through the requirement of translational invariance. The rest mass is constant in the special case of electromagnetic field only. A conservation law for the combination of the momentum and the energy momentum-tensor of the free field is derived. No satisfactory Hamiltonian formalism can be established within the framework of this formalism. (auth)

24491 ON THE INITIAL CONDITIONS IN THE THEORY OF IRREVERSIBLE PROCESSES. J. Philippot (Université, Brussels). Physica, 27: 490-6(May 1961). (In English)

A study is made of the physical significance of the initial conditions encountered in the van Hove and Prigogine theories of irreversible phenomena. It is shown that a random phase distribution does not permit the description of an isolated system in the case in which perturbations of the equilibrium state must be accounted for. It is also shown that the initial conditions used by Prigogine, which are defined by the Fourier expansion of the distribution function, represent either a Gibbs ensemble or a single "coarse grained" system. For the quantized case, the two theories permit inspection of the simple situation in which the initial state is defined by a proper, unperturbed Hamiltonian. (T.F.H.)

24492 QUANTUM VARIABLES AND THE ACTION PRINCIPLE. Julian Schwinger (Harvard Univ., Cambridge, Mass., and California Univ., Los Angeles). Proc. Natl. Acad. Sci. U. S., 47: 1075-83(July 1961).

The validity of the action principle is examined for the simplest quantum degree of freedom, V = 2. It is concluded that the action principle is still severely restricted in a practical sense. Computations are included. (C.H.)

24493 THEORY OF POLARON MOBILITY. Yukio Ōsaka (Tōhoku Univ., Sendai). Progr. Theoret. Phys. (Kyoto), 25: 517-36(Apr. 1961).

The polaron mobility is calculated by making use of the general theory of electrical conductivity. States determined by Feynman's trial action are taken as the unperturbed states, and the difference between the true action and the trial action is treated as a perturbation. Numerical values of the polaron mobility at very low temperatures are given. (auth)

24494 A NEW APPROACH TO THE THEORY OF CLASSICAL FLUIDS. III. GENERAL TREATMENT OF CLASSICAL SYSTEMS. Tohru Morita and Kazuo Hiroike (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 25: 537-78(Apr. 1961).

A classical system enclosed in a finite volume and affected by external forces is treated in a general way. The main results are partly applicable to solids as well as to fluids. Exact integral equations are found for the one- and two-particle distribution functions. Some thermodynamic functions are expressed in terms of these distribution functions. It is shown that there exist variational principles, which require that the grand partition function is at a maximum with respect to the variations in the one- and two-particle distribution functions. Variational principles are found also for the Helmholtz free energy. It is suggested that Mayer's theory of condensation may give the end point of the metastable gaseous state. It is pointed out that a hyper-netted chain approximation has a meaning in solids as well as in fluids. (auth)

24495 GEOMETRICAL STUDY OF THE PAIR DISTRIBUTION FUNCTION IN THE MANY-BODY PROBLEM. Masami Yamada (Waseda Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 25: 579-94(Apr. 1961).

The geometrical properties of pair distribution functions, which are independent of the properties of physical systems, are studied. Inequalities are found that are always satisfied by the pair distribution function; others are found that are satisfied when the particles have hard-cores. These inequalities serve as subsidiary conditions in variational treatments of many-body problems. (auth)

24496 ON THE STABILITY OF THE HARTREE-FOCK SOLUTION IN MANY-BODY PROBLEM. Katuro Sawada and Nobuyuki Fukuda (Tokyo Univ. of Education). Progr. Theoret. Phys. (Kyoto), 25: 653-66(Apr. 1961).

A necessary condition for the stability of the Hartree-Fock solution in the many-body problem is presented. If this condition is not satisfied, the solution becomes unstable because of one-dimensional spin wave effects. A variational method is proposed for construction of a stable solution having a lower energy than the Hartree-Fock value. The workability of the method is tested in some examples, such as the B.C.S.-Bogolyubov theory of superconductivity. The method is applied to field theory, which seems to be inconsistent in view of the presence of "ghost states." A canonical transformation leads to a new vacuum state with lower energy, but the high momentum part of the coupling is not damped. (auth)

24497 LOW DENSITY FERMION SYSTEM WITH STRONG ATTRACTIONS. Yasushi Wada (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 25: 713-14(Apr. 1961).

A low density system of fermions is considered which has a two-body interaction consisting of a combined hard core and square well. The energy distributions of the system are calculated for the cases in which the two-body interaction is repulsive, weakly attractive, and strongly attractive. (T.F.H.)

24498 DOUBLE DISPERSION REPRESENTATION OF VERTEX FUNCTION. Kunio Yamamoto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 25: 720-21(Apr. 1961).

A double dispersion representation of the vertex function is derived for the case in which one and only one of the mass variables is real and negative. The derivation makes use of the local commutativity and mass spectral properties of the vertex function. (T.F.H.)

24499 QUANTUM-MECHANICAL AND SEMICLASSICAL FORMS OF THE DENSITY OPERATOR THEORY OF RELAXATION. Paul S. Hubbard (Univ. of North Carolina, Chapel Hill). Revs. Modern Phys., 33: 249-64(Apr. 1961).

Nuclear magnetic relaxation phenomena are studied by means of a density operator formalism. Both quantum mechanical and semiclassical forms of a density operator relaxation theory are developed using this formalism. Both forms of the theory are applicable when the spin energy depends explicity on time, and both predict correctly the observed density operator. The relaxation of a system of identical spin-$\frac{1}{2}$ nuclei is calculated as an example. (T.F.H.)

24500 RECENT DEVELOPMENTS IN THE QUANTUM THEORY OF TRANSPORT AND GALVANOMAGNETIC PHENOMENA. M. Dresden (Univ. of Iowa, Iowa City). Revs. Modern Phys., 33: 265-342(Apr. 1961).

Current research in the quantum theory of transport phenomena is reviewed. Solid state and statistical mechanical considerations necessary for an understanding of the phenomena are outlined. The correlations between observed transport phenomena and parameters of transport theory are described. Calculations are carried out for the case of conductivity in the presence of a magnetic field. The main ideas of Boltzmann-type transport theory are reviewed. Such transport problems as relaxation, diffusion, and absorption are outlined. (T.F.H.)

24501 LECTURES IN THEORETICAL PHYSICS. VOLUME III. Lectures Delivered at the Summer Institute for Theoretical Physics, University of Colorado, Boulder, 1960. Wesley E. Brittin, B. W. Downs, and Joanne Downs, eds. New york, Interscience Publishers, Inc., 1961. 536p. $11.00

Lectures that were presented at the 1960 Summer Institute covered the following topics: Causality and dispersion relations; Selected topics in theoretical physics; Statistical mechanics of irreversibility; Scattering of electrons by atoms; Applications of the generating functional of the molecular distribution functions; Nonequilibrium statistical mechanics; Quantum theory of collision processes; Canonical commutation relations in field theory and function integration; General theory of nonequilibrium phenomena; Martin-Schwinger methods in the many-body problems; and Green's functions and the quantum theory of fields. Separate abstracts have been prepared for each lecture. (T.F.H.)

24502 CAUSALITY AND DISPERSION RELATIONS. Aage Bohr (Univ. of Copenhagen). p.1-53 of "Lectures in Theoretical Physics. Volume III." Wesley E. Brittin, B. W. Downs, and Joanne Downs, eds. New York, Interscience Publishers, Inc., 1961.

The properties of dispersion relations in quantum field theory are reviewed. The importance of the causality principle in the derivation of these relations is noted. The scattering of zero mass particles and of finite mass particles is studied by means of the correspondence treatment. The quantum mechanical basis for the correspondence treatment is studied. Particular attention is given to photon-nucleus and meson-nucleon interactions. (T.F.H.)

24503 SELECTED TOPICS IN THEORETICAL PHYSICS. Victor F. Weisskopf (Massachusetts Inst. of Tech., Cambridge). p.54-105 of "Lectures in Theoretical Physics. Volume III." Wesley E. Brittin, B. W. Downs, and Joanne Downs, eds. New York, Interscience Publishers, Inc., 1961.

Various topics of theoretical physics are outlined. The hypothesis that the Lorentz contraction is unobservable is examined. The existence of gravity waves in general relativity is investigated using the Mach principle. Quantum mechanical potentials, the Mössbauer effect, and chemical bonding are outlined. Pion-nucleon scattering is reviewed. Nuclear forces, matter, and reactions in low energy studies are discussed. (T.F.H.)

24504 STATISTICAL MECHANICS OF IRREVERSIBILITY. Robert W. Zwanzig (National Bureau of Standards, Washington, D. C.). p.106-41 of "Lectures in Theoretical Physics. Volume III." Wesley E. Brittin, B. W. Downs, and Joanne Downs, eds. New York, Interscience Publishers, Inc., 1961.

The classical and quantum statistical mechanics of irreversible processes are studied. The Prigogine treatment utilizes the classical ensemble distribution function and the Liouville equation, while the Van Hove treatment makes use of the density matrix. The latter method is used to derive the Pauli equation and the classical irreversibility conditions. Time effects and time correlation functions are studied. (T.F.H.)

24505 THE SCATTERING OF ELECTRONS BY ATOMS. B. L. Moiseiwitsch (Queen's Univ., Belfast). p.142-94 of "Lectures in Theoretical Physics. Volume III." Wesley E. Brittin, B. W. Downs, and Joanne Downs, eds. New York, Interscience Publishers, Inc., 1961.

The elastic and inelastic scattering of electrons by atoms is studied. The Born approximations, variational methods, scattering lengths, the Yukawa potential, and classical theory are discussed. For inelastic scattering, the cross sections are studied with reference to angular momentum and momentum transfer. For e-H collisions, the effects of ionization, excitation, polarization, and exchange are considered. The Born, strong-coupling, Bethe, distorted-wave, static-potential, Born-Oppenheimer, correlation, and exchange-correlation approximations are applied to this problem. (T.F.H.)

24506 SOME APPLICATIONS OF THE GENERATING FUNCTIONAL OF THE MOLECULAR DISTRIBUTION FUNCTIONS. Melville Green (National Bureau of Standards, Washington, D. C.). p.195-220 of "Lectures in Theoretical Physics. Volume III." Wesley E. Brittin, B. W. Downs, and Joanne Downs, eds. New York, Interscience Publishers, Inc., 1961.

The Bogoliuov generating functional of the molecular distribution function is studied. An explicit series solution is derived for the time dependence of the molecular distribution function, valid at low densities. The time dependence of the Ursell-Mayer function is also derived; this derivation is relevant to plasma theory. A quantum analog of the generating functional is described. (T.F.H.)

24507 NONEQUILIBRIUM STATISTICAL MECHANICS. Elliott Montroll (IBM Research Center, Yorktown Heights, N. Y.). p.221-325 of "Lectures in Theoretical Physics. Volume III." Wesley E. Brittin, B. W. Downs, and Joanne Downs, eds. New York, Interscience Publishers, Inc., 1961.

Statistical aspects of nonequilibrium and irreversible processes are reviewed, by consideration of Poincare cycles of systems. For assemblies of harmonic oscillators, the dynamic properties, time-relaxed correlation functions, momentum transition probabilities, equipartition effects, density matrices, and transport coefficients are outlined. For a system of free particles, the partition function and the equilibrium and time-relaxed pair distribution functions are studied. Particle interactions are examined from the standpoints of the Pauli and Boltzmann equations, and the example of vibrational relaxation of diatomic molecules is outlined. (T.F.H.)

24508 QUANTUM THEORY OF COLLISION PROCESSES. R. Haag (Univ. of Illinois, [Urbana]). p.326-52 of "Lectures in Theoretical Physics. Volume III." Wesley E. Brittin, B. W. Downs, and Joanne Downs, eds. New York, Interscience Publishers, Inc., 1961.

Two methods in formal collision theory are developed. In the first method the interaction Hamiltonian is divided into a free part and an interaction part. For this method, attention is devoted to the following concepts: classical, stationary, and explicit solutions; the initial and final state quantum configurations; the S-matrix Heisenberg formalism; the time dependent integral equations; and the plane wave configurations. The second method, which is valid for quantum field theory applications, is derived from the localized states concept. For this method, study is given to the use of the orthogonality and completeness conditions, invariance and conservation laws, integral equations, renormalization, and asymptotic conditions. (T.F.H.)

24509 CANONICAL COMMUTATION RELATIONS IN FIELD THEORY AND FUNCTIONAL INTEGRATION. R. Haag (Univ. of Illinois, [Urbana]). p.353-81 of "Lectures in Theoretical Physics. Volume III." Wesley E. Brittin, B. W. Downs, and Joanne Downs, eds. New York, Interscience Publishers, Inc., 1961.

Canonical representations of quantum field theory are discussed. The existence of inequivalent canonical representations, stemming from the infinite number of degrees of freedom, is studied. Attempts to classify these representations mathematically are outlined. Representations may be described in terms of the expectation functional, E(f); for given E(f), the uniqueness of the vacuum state, conjugate momenta, and Hamiltonian are proved. The concept of functional integration is reviewed. (T.F.H.)

24510 GENERAL THEORY OF NONEQUILIBRIUM PHENOMENA. Radu Balescu (Université Libre, Brussels). p.382-444 of "Lectures in Theoretical Physics. Volume III." Wesley E. Brittin, B. W. Downs, and Joanne Downs, eds. New York, Interscience Publishers, Inc., 1961.

The Liouville equation approach to the statistical mechanics of irreversible processes is studied. A solution is given for the Liouville equation. Factors affecting the initial conditions and subsequent behavior of systems are outlined. The results are applied to a study of the Fokker-Planck equation and long-range force effects in homogeneous plasmas. The theory is developed for homogeneous and inhomogeneous systems. (T.F.H.)

24511 MARTIN-SCHWINGER METHODS IN THE MANY-BODY PROBLEM. Neil Ashby (Harvard Univ., Cambridge, Mass.). p.445-89 of "Lectures in Theoretical Physics. Volume III." Wesley E. Brittin, B. W. Downs, and Joanne Downs, eds. New York, Interscience Publishers, Inc., 1961.

The Martin-Schwinger approach to the many-body problem, which is based on temperature-dependent Green's functions and other field theoretic techniques, is reviewed. The theory is used to find the current in a system caused by an external magnetic field, the conductivity of a system, and the ground state properties of nuclear matter. (T.F.H.)

24512 GREEN'S FUNCTIONS AND THE QUANTUM THEORY OF FIELDS. Kurt Symanzik (Inst. for Advanced Study, Princeton, N. J.). p.490-531 of "Lectures in Theoretical Physics. Volume III." Wesley E. Brittin, B. W. Downs, and Joanne Downs, eds. New York, Interscience Publishers, Inc., 1961.

The properties of nonlinear Green's functions, i.e., Green's functions for nonlinear systems, are studied in the framework of quantum field theory. In order that a solution for a nonlinear system may be found, the many-particle structure of the perturbation expansion for the system must be known. If this structure can be incorporated exactly into the Green's function, the system is soluble. (T.F.H.)

24513 ON QUANTUM MECHANICS IN ACCELERATION FIELD. Nagatoshi Tunazima. Tokyo, Sanshusa Press, 1960. 43p.

A general relativistic treatment of the electrostatic field is presented. The Dirac wave equation is adapted into a form applicable to highly accelerated systems. The motion of k-shell electrons in heavy atoms is studied as an example. Energy levels are calculated for these electrons, and are compared with energy levels found from x-ray absorption data. (T.F.H.)

REACTOR TECHNOLOGY

General and Miscellaneous

24514 (AD-248402) REACTORS DEVELOPED IN THE USSR AND ITS BLOC COUNTRIES. (Library of Congress. Air Information Div., Washington, D. C.). Oct. 31, 1960. 78p. (AID-60-77)

Tables on reactors developed in the USSR and its bloc countries are presented which were compiled from Soviet monographs, reports, conference proceedings, and public media. Research and power reactors are included. A bibliography of 146 references is given. (D.L.C.)

24515 (AD-250071) REACTOR SHIELDING. (Bibliography). (Library of Congress. Air Information Div., Washington, D. C.). Dec. 7, 1960. 25p. (AID Report 60-102)

A guide to Soviet publications dealing with reactor shielding and radiation protection is presented. Reference (191) are taken from USSR monograph, periodicals, and papers published between 1958 and Nov. 1, 1960. Titles of references taken from periodicals are translated and given in English only; titles of monographs are given in Russian followed by an English translation. Library of Congress call numbers are included at the end of entries when the source is cataloged and available. (auth)

24516 (ANL-6078) ZERO-POWER EXPERIMENTS ON THE ARGONNE LOW POWER REACTOR (ALPR). D. H. Shaftman (Argonne National Lab., Ill.). May 1961. Contract W-31-109-eng-38. 103p.

Results are summarized for zero-power measurements carried out on the ALPR to study the characteristics of fuel assembly arrays, burnable poison strips, and control rods. The criteria were stable reactor operation at the design power of 3 Mwt, enough explicit and inherent reactivity for reactor operation for as long as 3 years, and enough control capacity for shutdown at any time during the core cycle. Two reference cores were used in the measurements: a final reference 40-fuel-assembly core for 3 Mwt operation and a reference 59-fuel-assembly loading for possible use at higher power levels in another plant. Aspects of design of the core and control system are discussed. (D.L.C.)

24517 (ANL-6325) SEAM-WELDED TUBULAR FUEL ELEMENTS FOR USE IN CP-5. L. C. Hymes (Argonne National Lab., Ill.). May 1961. Contract W-31-109-eng-38. 9p.

ALPR fuel plates were converted into tubular fuel elements for use as additional fuel for the CP-5 reactor. The fabrication was carried out by introducing a cross-rolling step in the ALPR rolling schedule and roll-forming tubes from these plates. (D.L.C.)

24518 (APAE-87) SM-1 RESEARCH AND DEVELOPMENT PROGRAM. DECONTAMINATION OF SM-1 PRIMARY SYSTEM, TASK XVI–PHASE I. L. F. Donovan (Alco Products, Inc., Schenectady, N. Y.). June 20, 1961. Contract AT(30-3)-326. 117p.

A method is reported for decontaminating the SM-1 steam generator. Special plugs will be inserted in the reactor outlet nozzle and the casings of both primary coolant pumps to isolate the steam generator from the remainder of the primary system and to allow for introduction and removal of the decontamination solutions. Radioactive deposits will be removed by circulating a solution of caustic permanganate followed by a water rinse, ammonium citrate–citric acid–Versene 9 solution, and several more water rinses. The results obtained from a feasibility study of decontaminating the entire SM-1 primary system with the core removed, are given. Preliminary corrosion data are reported. Two methods for draining the lower portion of the reactor vessel also are presented. (D.L.C.)

24519 (APAE-88) INVESTIGATION OF LOCAL BOILING OF SM-1. P. L. Bradley (Alco Products, Inc., Schenectady, N. Y.). June 20, 1961. Contract AT(30-1)-2639. 62p.

SM-1 Reactor Core I Rearranged and Spiked, and Core II with Special Components were analyzed under various off-design conditions to induce nucleate boiling. The steady state code, STDY-3, written for the thermal analysis of pressurized water cores, was employed for the analysis. The code performs a complete steady state parallel channel thermal analysis for both nominal and hot channels. Thermal characteristics of individual elements were investigated while changing the parameters of primary pressure or inlet temperature to introduce the phenomenon of nucleate boiling in the core. Reduction of system pressures to 1000, 800, and 600 psia and increasing core inlet temperatures to 465 and 500°F were studied as the means to induce boiling in the core. This analysis indicates that SM-1 Core I Rearranged and Spiked can be safely operated at the reduced pressure of 910 psia without introducing extensive boiling in the core. SM-1 Core II with Special Components can be operated at 800 psia or at an inlet temperature of 500°F at 1200 psia. (auth)

24520 (BNL-669) A COMPARISON OF SOME ONE-VELOCITY TRANSPORT APPROXIMATIONS IN LATTICES. Yuzo Fukai (Brookhaven National Lab., Upton, N. Y.). May 1961. 10p.

In calculating a closely packed lattice, it is well known that one-velocity integral transport theory is a most useful method. Results are presented for calculation of the ratio of fuel to moderator flux in a lattice ($\bar{\phi}_f/\bar{\phi}_\theta$) by first and second-order approximations, the effect on this ratio of change in lattice dimensions, and results for the flux ratio in various kinds of lattices. (auth)

24521 (CF-61-6-85) THE INFLUENCE OF RESIDENCE TIME DISTRIBUTION ON FISSION PRODUCT DECAY IN THE MSRE PUMP BOWL AND OFF-GAS LINE. C. W. Nestor (Oak Ridge National Lab., Tenn.). June 23, 1961. Contract W-7405-Eng-26. 5p.

A study was made of the influence of residence time distribution on fission product decay in the MSRE pump bowl and off-gas line. The calculated decay rates in the pump bowl do not differ by more than 30% for a large variation in the assumed shape of the distribution; however, for the same variation there may be a difference of a factor of 10 in activity entering the off-gas line. If one compares an exponential distribution with a gamma distribution with parameter 2, the difference is a factor of 2; these distributions are felt to be physically reasonable ones. (auth)

24522 (CRRP-872(App.6)) THE EFFECT OF FLUX FLATTENING ON THE ECONOMICS OF HEAVY WATER MODERATED REACTORS. APPENDIX 6. Fourth Reference CANDU Reactor. W. J. Henderson and D. G. Hurst (Atomic Energy of Canada Ltd., Chalk River, Ont.). June 1961. 19p. (AECL-949(App. 6))

Changes were made in the dimensions of the CANDU pressure and calandria tubes, the number of fuel sites was decreased from 316 to 306, the thermal cycle was modified, and a few other changes were made. Lattice formulas were modified. Calculations of the burnup from the Fourth Reference CANDU Reactor predicted 8807 MWD/T. Changes in the fission product yields, resonance absorption in fission products, and neutron temperatures are discussed. The fluxes, power, and fuel rate were plotted. Cost details are given. (M.C.G.)

24523 (GEAP-3494) SUMMARY PHYSICS REPORT OF T7 TANKER REACTOR CONTROL SYSTEM. O. A. Thompson and H. A. Brammer (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Jan. 18, 1961. Contract AT(04-3)-189. 58p.

The results are presented for some studies of the characteristics and design of internally moderated or "flux trap" control elements for the T7 Tanker reactor. Basic characteristics of flux traps are analyzed. A method is given which permits designing these control elements into a system required to meet a stuck rod criterion in a uniform core. Extension of the results to the multiple zone T7 core is considered. (D.L.C.)

24524 (IDO-16635) THE DEPENDENCE OF REACTOR BEHAVIOR ON THE SELF-SHUTDOWN MODE. S. G. Forbes (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 25, 1961. Contract AT(10-1)-205. 39p.

Relationships for obtaining the figure of merit or safety index of a reactor were formulated for the restricted case of reactor self-shutdown with step and ramp reactivity disturbances. The properties of reactor kinetics equations are examined for postulated forms of the coupling equation. The results show that the reactor safety index is strongly dependent on the nature of the reactivity feedback. It is concluded that an approximate analysis of reactor design which is based on a knowledge of feedback processes will indicate the directions to be taken for maximum gains in reactor safety. (D.L.C.)

24525 (JAERI-4018) TECHNICAL ASPECTS OF AQUEOUS HOMOGENEOUS REACTOR. (Japan Atomic Energy Research Inst., Tokyo). 1961. 54p.

Technical problems of an aqueous homogeneous reactor are reviewed with attention to the solution core and slurry blanket types. Aqueous homogeneous reactors encounter significant difficulties which are mainly attributed to the fuel instability and raw slurry techniques, although they have the highest potentiality of thermal breeding and many promising features. The fuel instability is believed to have been responsible for two holes in the HRE-2 core tank. The fact that the surface of phase instabilities such as two-phase separation lies above the possible operating region for aqueous homogeneous reactors probably resulted in the autocatalytic events: deposition of uranium, overheating, and meltdown. Concerning the slurry techniques, the lack of experience in a slurry reactor is serious. The radiation effect on slurry behavior is not yet clear, and many improvements should be made on the components of the slurry system. The slurry boiling concept appears to be promising, because elimination of outer loops will obviate laborious development. It is believed that efforts should be concentrated on the following principal points: 1) The overcoming of the difficulties due to the fuel instability (probably by the proper hydrodynamic design and improved core materials). 2) The achievement of adequate material control, without an accumulation of slurry in unexpected recesses in the slurry reactor. (auth)

24526 (LAMS-2519) NUCLEAR ROCKET PROPULSION. A Selected Bibliography of the Unclassified Literature. R. W. Bussard, comp. (Los Alamos Scientific Lab., N. Mex.). May 17, 1961. Contract W-7405-ENG-36. 22p.

A bibliography of 171 references on nuclear rocket propulsion is presented, divided into three sections dealing with applications of fission energy to propulsion, specific studies of propulsion systems, and potential advanced propulsion systems. (D.L.C.)

24527 (LAMS-2541) 2000 KILOWATT SODIUM TEST FACILITY. Project Description and Progress Reports, June 30, 1958 through September 30, 1959. L. A. Whinery (Los Alamos Scientific Lab., N. Mex.). Mar. 1961. Contract W-7405-ENG-36. 119p.

The design and construction work completed on the 2000-kw Sodium Test Facility during the period from April 1958 to Oct. 1959 is described. The purpose of the facility project is to test models of equipment components which are to be used in a molten plutonium, sodium-cooled fast reactor. (D.L.C.)

24528 (LAMS-2564) QUARTERLY STATUS REPORT ON LAMPRE PROGRAM FOR PERIOD ENDING MAY 20, 1961. (Los Alamos Scientific Lab., N. Mex.). June 1961. Contract W-7405-ENG-36. 23p.

LAMPRE-I. The reactor was started up and held at 160°C and at hot critical for various measurements. Some of the 160°C measurements included rod worth, temperature coefficient, and shim-down extrapolated mass. In the approach to hot critical, multiplication was measured during the temperature increase from 160 to 500°C and found to increase markedly when the core melted. Reactivity changes due to jarring of the fuel capsules to remove bubbles and voids in the melted fuel were observed. Zero measurements made at 480°C are reported. Power coefficient measurements at 0 to 45 kw and power demand experiments were made, and the 50-kw transfer function is plotted. Shielding inadequacies are discussed briefly. The results of a fuel pin scan are given. Observations on the performance of the sodium system are discussed. Type 17-4 PH stainless steel was found to undergo additional grain boundary precipitation during long-term exposure to temperatures below the hardening temperature, and measurements of its properties are reported. Fuel and Container Development. Impurities in the LAMPRE-I fuel which has a corrosive effect on the fuel container are discussed. Observations in the Pu–Ce–Co phase diagram are reported. Different types of LAMPRE-I capsule failure are discussed. Work on improving the corrosion resistance of Ta revealed Y and W to be beneficial additives. Sodium Test Facility. The test facility was operated nearly continuously, with test equipment pieces receiving total operating times as high as 10,400 hr. The He cover gas in the primary and secondary loops was analyzed for buildup of O_2, H_2, and CH_4. (D.L.C.)

24529 (NAA-SR-4488(Suppl.)) SRE FUEL ELEMENT DAMAGE. Final Report. R. L. Ashley, R. J. Beeley, F. L. Fillmore, W. J. Hallett, B. R. Hayward, Jr., and A. A. Jarrett (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 30, 1961. Contract AT-11-1-GEN-8. 60p.

Following power run 14 on the Sodium Reactor Experiment, 13 of the 43 fuel elements were found to be damaged. An Ad Hoc Committee was established to assist in determining the source of the difficulty, to review and advise on steps taken to return the reactor to operation, and to recommend any necessary changes in the reactor system or in operating procedures to avoid a recurrence. An Iterim

Report was issued which presented the evidence available at that time as to the cause of the damage. Included is the concluding report of the Ad Hoc Committee. The conclusion as to cause of the fuel element failures was modified on the basis of data developed since the first report was written. Several modifications were made to the reactor system to avoid a recurrence. (auth)

24530 (NDA-2131-23) INVESTIGATION OF REACTOR TRANSIENTS AND POWER PATTERNS OF A HEAVY WATER-MODERATED, BOILING HEAVY WATER-COOLED REACTOR. C. Graves, F. E. Beers, L. Berkowitz, H. G. Elrod, Jr., and C. Marotta (Nuclear Development Corp. of America, White Plains, N. Y.). Mar. 21, 1961. Contract AT(30-1)-2303(IX). 58p.

Studies were made of the possibility of reactor instability and flux pattern perturbations in boiling D_2O-moderated reactors due to the small but positive coolant void coefficient. The results for constant reactor inlet conditions indicate that a positive coolant void coefficient up to twice the calculated values does not introduce any serious control problems for either the 70-Mwe prototype or 200-Mwe full-scale plant. The reactor exhibits a mild transient response to appreciable step insertions in reactivity but stabilizes at the new steady-state power without corrective control action, and the peak surface heat fluxes are well below the boiling burnout limit. Magnification of local flux pattern through interaction with the positive coolant void coefficient should not lead to local boiling burnout. (D.L.C.)

24531 (ORO-417) FUEL-BEARING FIBERGLAS IN ALUMINUM-BASE FUEL ELEMENTS—SIXTH QUARTERLY REPORT, JANUARY 1, 1961 TO MARCH 31, 1961. R. H. Baskey (Clevite Corp. Mechanical Research Div., Cleveland). May 3, 1961. Contract AT-(40-1)-2557. 17p.

Depleted, aluminum-coated, uranium-bearing fiberglas was used as core material for processing experimental fuel plates. Cladding the plates with alclad 5154 or alclad fiberglas-reinforced aluminum resulted in uniform crack-free core sections. The test program to be conducted with enriched plates is described. The results of bending tests with various clad depleted plates are reported; cladding with high-strength aluminum alloys was found to increase the formability to the extent that an alclad 5154 plate could be bent up to 180° at 450°F without breaking. (D.L.C.)

24532 (SL-1857-4) REACTOR CONTAINMENT DESIGN STUDY. Bimonthly Progress Report, April 15, 1961–June 15, 1961. R. A. Johnson (Sargent and Lundy, Chicago). June 26, 1961. For Armour Research Foundation. Contract AT(11-1)-938. 18p.

The work on the economic and technical feasibility study of various reactor containment schemes, was completed. The results of this study are contained in Report SL-1868. Other activities were concerned primarily with the design and cost evaluation of various components for the proposed test facility. Investigations during the past bimonthly period were concerned with the containment vessel, type of access openings for the containment vessel, an enclosure for the vessel, the source vessel for storing the hot water for experimental purposes, methods of supplying the hot water for experiments, and cost of piping for the facility. A meeting was held to discuss considerations for testing the containment vessel if the proposed test facility were to be located within the city limits of Chicago. Designs of flanged openings for access to containment vessel were also discussed. (auth)

24533 (SL-1868) REACTOR CONTAINMENT DESIGN STUDY. R. A. Johnson and I. Nelson (Sargent and Lundy, Chicago). May 18, 1961. Contract AT(11-1)-938. 177p.

An economic and technical feasibility study of various reactor containment designs for power plants now under construction was made. Design calculations, flow diagrams and general arrangement drawings were prepared. The plants were normalized, keeping the arrangement of all plants of a given size as nearly the same as practicable. Auxiliary systems, fuel handling, accessibility to equipment, etc., were made equivalent except where some variation was necessary for a given containment concept. Radiation calculations were also made to determine the effects and cost as reflected in shielding and exclusion areas. Material take-offs were made of structural, mechanical and electrical equipment and installations wherever there were differences in plant designs. These take-offs were then used to prepare estimates of the differences in costs of the plants. Standard containment was used as the base for the cost comparison. In regard to the technical aspects of containment, all of the methods studied were found to be technically feasible. Standard containment was utilized for most reactor plants constructed to data and has received wide public acceptance. However, the other containment schemes studied appear to be equal or better than standard containment in most respects. Present technology is such that containment designs are based on very conservative assumptions. Conservatism generally results in increased costs for design fabrication and construction. More technical data and experience are needed in order that plants may be designed to more realistic bases. Additional technology should also lead to the development of new concepts as well as to improvements in present containment methods which should add to the safety of reactor plants as well as reducing the cost of containment. (auth)

24534 (TID-3525(Rev.3)) REACTOR SAFETY. A Literature Search. Richard J. Smith, comp. (Office of Technical Information Extension, AEC). July 1961. 76p.

A bibliography of 741 unclassified research and development reports on reactor safety is presented. The reports treat subjects such as reactor systems, materials, and operation designed for maximum safety, and hazardous incidents and operations. (D.L.C.)

24535 (TID-7610(p.44-57)) REMOVAL OF VOLATILE FISSION PRODUCTS FROM GASES. W. E. Browning, Jr., R. E. Adams, and R. D. Ackley (Oak Ridge National Lab., Tenn.).

Provisions for the removal of radioactive gaseous fission products which may be present in a flowing carrier gas stream in various nuclear operations are discussed. One method for removing radioactive noble gases from gas streams is based on physical adsorption. Retention times for noble gases in adsorbers were measured by tracer techniques. The effects of various factors such as type of adsorbant, temperature of adsorbant, type and velocity of carrier gas, geometrical configuration of adsorber, and partial pressure of the fission gas were investigated. Methods of handling iodine were somewhat different because of its relative immobility in adsorbers. Labeled iodine was injected into an air stream passing through the material under test. Analyses were made of the effluent for iodine to determine the effectiveness of the adsorber. Activated charcoal was found to be the most efficient material for removing both noble gases and iodine for gas streams. Methods for dose calculations are discussed. (M.C.G.)

24536 (TID-7610(p.122-34)) RECENT DEVELOPMENTS IN AQUEOUS HOMOGENEOUS REACTOR FUEL

SOLUTION CHEMISTRY. M. J. Kelley, W. L. Marshall, and H. F. McDuffie (Oak Ridge National Lab., Tenn.).

General results of recent research on the chemistry of reactor fuel solutions as related to the problems arising from reactor operation with such fuels are summarized. The temperature range in which unsaturated $UO_2SO_4-H_2O$ solutions are stable is discussed. The uranyl sulfate–copper sulfate–water systems used in the HRE-2 were also studied. Phase-transition temperatures and mutual solubilities were determined. (M.C.G.)

24537 (HW-tr-25) THE GENERAL FORMULATION AND PRACTICAL CALCULATION OF THE DIFFUSION COEFFICIENT IN A LATTICE CONTAINING CAVITIES. P. Benoist (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Translated by Liz Appleby (Hanford Atomic Products Operation) from report CEA-1354, 1959. 73p.

The calculation of diffusion coefficients in a lattice necessitates the knowledge of a correct method of weighting the free paths of the different constituants. An unambiguous definition of this weighting method is given, based on the calculation of leakages from a zone of a reactor. The formulation obtained, which is both simple and general, reduces the calculations of diffusion coefficients to that of collision probabilities in the different media: it reveals in the expression for the radial coefficient the series of the terms of angular correlation (cross terms) recently shown by several authors. This formulation is then used to calculate the practical case of a classical type of lattice composed of a moderator and a fuel element surrounded by an empty space. Analytical and numerical comparison of the expressions obtained with those inferred from the theory of Behrens shows up the importance of several new terms, some of which are linked with the transparency of the fuel element. Cross terms up to the second order are evaluated. A practical formulary is given. (auth)

24538 (NP-tr-642) LIQUID-METAL COOLANTS IN NUCLEAR REACTORS. (Zhidkometallicheskiye Teplonositeyaye Yadernykh Reaktorov). P. A. Andreev (Andreyev), A. A. Kanaev (Kanayev), and E. (Ye.) D. Fedorovich. Translated from a Russian Publication, Leningrad, 1958. 463p.

Information on the properties of liquid metals used as coolants in nuclear reactors is presented. Topics discussed include heat transfer in the liquid phase or during boiling and condensation, the interaction of liquid metals with structural materials, methods for removing impurities from liquid metals, and the peculiarities of design and operation of systems with liquid metals as coolants. The requirements to be met by heat transfer media used in nuclear reactors and ways to raise the efficiency of atomic power plants employing liquid metal coolants are outlined. (M.C.G.)

24539 THE LIFE OF SOME METALLIC URANIUM BASED FUEL ELEMENTS. J. A. Stohr and M. Englander (Centre d'Etudes Nucléaires, Saclay, France). Atti congr. sci., Rassegna intern. elettronica e nucleare, 5a, Rome, 1: 215-31(1958). (In Italian) (CEA-1063)

A description is given of some theoretical and experimental data concerning the design and most economic preparation of metallic uranium based fuel elements, which are intended to produce an energy of 3 kw days/g of uranium in a thermal reactor, at a sufficiently high mean temperature. Experimental results obtained by testing by analogy or by actually trying out fuel elements obtained by alloying uranium with other metals in proportions such that the resistance to deformation of the alloy produced is much higher than that of pure metallic uranium and that the thermal utilization factor is only slightly different from that of the uranium. (auth)

24540 EXPONENTIAL EXPERIMENTS ON NATURAL URANIUM-IMPREGNATED GRAPHITE LATTICES. R. Bonalumi, C. Bruschi, G. B. Zorzoli (Laboratori CISE, Segrate, Italy). Energia nucleare (Milan), 8: 321-5(May 1961). (In English)

Exponential experiments on natural uranium-impregnated graphite lattices are described. Buckling was measured on three different lattice pitches, corresponding to spacings of 10, 14.1, and 20 cm; the experimental results are discussed. (auth)

24541 FAST NEUTRON SPECTRA AND DOSE-RATE CALCULATIONS. J. B. Eggen, R. L. French, and A. Reetz, Jr. (Convair, Fort Worth, Tex.). Health Phys., 5: 119-25(June 1961).

A method and its application for calculating fast-neutron spectra and dose rates about the Lid Tank Facility source plate, the Bulk Shielding Reactor, and the Aircraft Shield Test Reactor are described. The method may be applied to any reactor whose shield is composed largely of hydrogenous materials. Dose rates and spectra calculated by the method are useful in shield design and in the analysis of experiments performed in reactor radiation fields. The method is based upon fast-neutron differential energy spectra and dose rates calculated for a point isotropic fission source in infinite media. These data represent a moments method solution of the Boltzmann transport equation for water and hydrocarbons. By representing a reactor core as an array of point isotropic sources and assuming that any material along the line-of-sight between a point source and a point detector may be represented by an equivalent thickness of water or hydrocarbon, the fast-neutron attenuation through any material may be determined by use of the results for these reference materials. The equivalent thickness of non-hydrogenous material is determined from the ratio of the effective removal cross sections. Results from dose-rate calculations agree with measured BSR and LTSF pure water centerline data within 10%. Calculated and measured spectra for the BSR and the ASTR compare favorably, although the ASTR calculation involves penetration of considerable amounts of non-hydrogenous materials. (auth)

24542 EXERGETIC EVALUATION OF HETEROGENEOUS REACTORS. W. Fratzcher and R. Nitsch. Kernenergie, 4: 269-75(Apr. 1961). (In German)

In the present work an equation for the determination of the exergetic efficiency of a heterogeneous reactor is given. The efficiency can be given as a function of four dimensionless characteristics which can be clearly explained. The numerical evaluation of the efficiency makes it possible to compare thermodynamically different reactions with each other and with other heat sources. (tr-auth)

24543 THE PROBLEM OF CONSTANT POWER DENSITY IN PRESSURIZED WATER REACTOR. (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 4: 384-90(May 1961). (In German)

The enrichment of the uranium was determined as a function of the radius under the conditions of equal uranium/water ratios and stable rod dimensions. This gives a radially constant power density for a reflected pressurized water reactor. The power density was then calculated in dependence on the radius for a two- and three-zone arrangement with constant enrichments in each zone, which are equal to the mean value of the ideal enrichment over

the zone concerned. The advantages and disadvantages of the two- and three-zone classification with periodic transposition of the fuel elements were estimated. (tr-auth)

24544 LONG-TERM BEHAVIOR OF THERMAL REACTORS. Heinz Hortsmann (Institut für Reine und Angewandte Kernphysik, Kiel). Kerntechnik, 3: 200-4(May 1961). (In German)

Local changes in the fuel composition as a consequence of combustion, and their influence on the neutron reproduction factor and diffusion length are examined. These local changes of the neutron-physical properties of the fuel determine the behavior of neutron flux and total reactivity. Their calculation as a function of combustion is explained. (auth)

24545 NATURAL URANIUM AS A REACTOR FUEL. H. N. Schludi. Kerntechnik, 3: 208-10(May 1961). (In German)

Natural uranium fuel rods of equal strength made of uranium metal and UO_2 are investigated as to their maximum excess reactivity. The result is that with high moderation, a maximum reactivity gain of 0.020 is obtained with uranium metal as compared to UO_2. As regards the maximum excess reactivity, a metallic natural uranium fuel rod is equivalent to a UO_2 fuel rod of equal strength enriched to 0.748% uranium-235. (auth)

24546 ON THE HEATING-UP OF PHOTONEUTRON SOURCES IN REACTORS. H. A. Sandmeier (Argonne National Lab., Ill.). Kerntechnik, 3: 215-16(May 1961). (In German)

If photoneutron sources remain in the reactor after start-up, they are subject to considerable thermal heating due to various processes. These processes are discussed. (auth)

24547 SIMULATION OF REACTORS WITH SMALL COMPUTERS. A. Reinhardt. Kerntechnik, 3: 221-6 (May 1961). (In German)

After a consideration of the required calculating units comprising, in addition to the principal circuit technique, indications for characteristic data, programs are stated for the paper facsimile of a zero-power-reactor. For these programs, calculating units and resistance-condenser networks are used. According to a further program, the start-up behavior of the reactor can be simulated for about 5 decades of neutron flux change. With the aid of a circuit, it is shown that the paper facsimile of complete power reactors with a nuclear part, a complete primary cooling circuit, and a secondary part with a power output is possible with a table-model calculator. (auth)

24548 APPLICATIONS OF GEOMETRIC THEORY TO NONLINEAR REACTOR DYNAMICS. Elias P. Gyftopoulos (Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng., 10: 254-68(July 1961).

Some basic theorems of the geometric theory of differential equations are reviewed, without proofs, in an attempt to clarify: (a) what relationship exists between the general solution of a set of nonlinear differential equations and the solution of its linear approximation and under what conditions this relationship can be used; (b) how the geometric theory can be used to find properties of boundedness, stability, and periodicity of the solutions of nonlinear differential systems. These theorems are illustrated by means of two-third order examples. The first is the xenon controlled reactor and the second a two-region reactor with two temperature coefficients of reactivity. It is shown without involved computations or any approximations that: (a) Xenon controlled reactor — when the reactivity controlled by xenon is smaller than the prompt xenon yield, the reactor power is always bounded but periodic oscillations may arise. When the reactivity controlled by xenon is greater than the prompt xenon yield the reactor power is unbounded; (b) Two-region reactor — this reactor does not admit periodic solutions. When the temperature coefficients are of opposite sign, conditions are derived for the reactor power to be bounded. (auth)

24549 HYDRODYNAMIC MODELS FOR THE TREATMENT OF REACTOR THERMAL TRANSIENTS. J. E. Meyer (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 10: 269-77(July 1961).

Several calculational models for the treatment of transient fluid flow through reactor coolant channels were studied in order to determine their suitability for digital computer application. A momentum integral model has been judged most appropriate for a wide class of intermediate speed transients on the basis of balancing adequacy of physical description against numerical simplicity and computer time requirements. (auth)

24550 AN INTERATIVE SOLUTION OF THE KINETIC REACTOR EQUILIBRIUM SYSTEM FOR ROD-DROP EXPERIMENTS. Walter Hage and Ian R. Cameron (United Kingdom Atomic Energy Establishment, Winfrith, Dorset, Eng.). Nukleonik, 3: 76-80(May 1961). (In German)

An iterative solution of the kinetic reactor equilibrium system for negative reactivities ($|\rho| > 10^{-2}$) and a short prompt neutron lifetime ($l < 10^{-3}$ sec) was derived. The neutron content is given as a polynomial of $\beta/(\beta - \rho)$ with time-dependent coefficients. The equations derived are usable in the evaluation of measurement results of rod-drop experiments for the calibration of control rods. Changes in the spatial and energy-dependent neutron distribution were not considered. (tr-auth)

24551 EXACT TWO-GROUP DIFFUSION THEORY OF THE FINITE HETEROGENEOUS STRATIFIED REACTORS. E. Eberth and W. Oldekop (Siemens-Schuckertwerke AG., Erlangen, Ger.). Nukleonik, 3: 80-3(May 1961). (In German)

The earlier described method (Oldekop, Nukleonik 2, 252(1960)) for the exact calculation of finite heterogeneous reactors with plate-life fuel elements was specialized to the case of the two-group calculation. The exact k_{eff} value resulted from a quadratic equation whose coefficients depend on the material constants and the geometric dimensions. The exact k_{eff} values for various reactor dimensions were compared with the values calculated by the elementary 6-factor formula. The slight deviations in suitable factor calculation depend practically only on the total buckling. A nominal anisotropy effect can not be established in the natural U/D_2O plate lattice considered. (tr-auth)

24552 NOTE ON THE SIMULATION OF NUCLEAR REACTORS. Gian Paolo Caligiuri (Università, Rome). Riv. ing., No. 3, 9p.(Mar. 1960). (In Italian)

The electronic simulation of nuclear reactors is discussed. A network scheme simulating the reactor slab is presented which will solve the two-group diffusion equations using a simple amplifier. Then the network for the case where neutron density variation with time is not zero is considered. Finally a scheme is offered for simulating Xe^{135} poisoning. (T.R.H.)

24553 APPLICATION OF VARIATIONAL METHODS IN DETERMINING CRITICALITY PARAMETERS OF SPHERICAL REACTORS. N. I. Kozlov. p.143-64 of "Nekotorye

Matematicheskie Zadachi Neitronnoi Fiziki." Publishing House of the Moscow University, 1960.

Reactor criticality is determined on the basis of a single-rate kinetic equation. The reactor represents two concentric spheres. The inner sphere is filled with fissioning material, the outer with scattering material (reflector). The integral equation describing the criticality is resolved by variational methods. (R.V.J.)

24554 APPLICATIONS OF VARIATIONAL METHODS FOR CALCULATING CYLINDRICAL REACTOR CRITICALITY. F. F. Mikhailus. p.165-82 of "Nekotorye Matematicheskie Zadachi Neitronnoi Fiziki." Publishing House of the Moscow University, 1960.

Self-sustaining operation of a long cylindrical reactor is studied by a single-rate approach. The problem is resolved by variational methods assuming that all neutrons have identical energies (fission energy) and that both scattering and fission are isotropic in the inertia system. (R.V.J.)

24555 PROBLEMS IN THE USE OF THIN ZIRCALOY CLADDING FOR URANIUM DIOXIDE FUEL. G. H. Chalder (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.57-78 of "Fuel Element Fabrication with Special Emphasis on Cladding Materials. Volume 1." London and New York, Academic Press, 1961. (In English)

Information on development, testing, and manufacture of fuel for the 20 Mwe Nuclear Power Demonstration reactor is presented. In this reactor, the fuel elements will consist of sintered uranium dioxide pellets clad in Zircaloy-2, and assembled into short bundles to facilitate continuous, bi-directional, on-load fueling. Some of these bundles will comprise 7 fuel elements; the remainder will have 19 fuel elements. The diameter/wall ratio of the cladding sheath in both these fuel designs is such that, if unsupported, the sheath would collapse under the reactor coolant pressure. Fuel/sheath clearances and UO_2 pellet shape are studied with relation to sheath distortion during operation. The fabrication process for UO_2 pellets employs uranium dioxide powder, prepared from ammonium diuranate (ADU), pressed into pellets without the use of a binder, and sintered in hydrogen to a density of 92 to 96% of theoretical. Problems of quality and reproducibility in production are described. The presence of small cracks at the external and internal surfaces of seamless Zircaloy sheathing tubes has caused concern about the effect of these on fuel performance. A review is given of available information on the correlation of these defects with tube fabrication history, and on methods for their detection. In the assembly of fuel elements and bundles, Zircaloy welding, both for the end sealing of fuel elements and for the attachment of wire spacers is carried out in a simple enclosure employing a dynamic argon atmosphere. Finally, a review is made of current investigations designed to provide higher fuel performance or lower fabrication costs. These include the improvement of thermal conductivity and fission gas retention properties of UO_2, the integral fabrication of fuel elements by swaging or vibratory compaction methods, and the use of improved methods of welding or joining the fuel assemblies. (auth)

24556 OPTIMIZING REACTOR SHIELD PROPELLANT BOILOFF AND TANK PRESSURE. R. F. Trapp and J. H. Wilson (Douglas Aircraft Co., Inc., Santa Monica, Calif.). [Paper No.] 1757-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 17p.

Nuclear vehicles are faced with a new design interaction, comprising reactor radiation leakages and the induced propellant heating caused by that radiation. Shielding may be placed about the reactor to limit the amount of leakage radiation energy. The propellant boiloff, for a given mission, is inversely related to the reactor shield thickness and the tank pressure. However, the weight of the shield is directly related to its thickness and the weight of the tank is directly related to the pressure. Thus there appears to be an optimum combination of shield, boiloff, and tank pressure. Results of a computer program that examines the variables involved in the propellant boiloff are presented. These results include the effect of shield thickness and tank pressure. (auth)

24557 ON THE USE OF NUCLEAR ROCKET AFTERCOOLANTS FOR BOOSTER RECOVERY. J. W. Eerkens (Aerospace Corp., Los Angeles). [Paper No.] 1758-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 17p.

The possibilities of using the aftercoolants of a recoverable nuclear rocket as expellants for booster braking and de-orbit during re-entry are investigated. The nuclear afterheat generation and coolant requirements are calculated as functions of rocket thrust and burning time. Hydrogen is found to be the optimum aftercoolant and retropellant. Reactor design problems encountered in the braking process are evaluated. The usefulness of this procedure is studied in de-orbiting and braking phases of re-entry after a once-around-the-earth trajectory. (T.F.H.)

24558 FUEL ELEMENTS FOR NUCLEAR REACTORS. Hugo Heinrich Ludolf Ritz (to C. A. Parsons & Co., Ltd.). British Patent 870,263. June 14, 1961.

The design of a nuclear fuel element which comprises a series of closed tubular containers housing nuclear fuel and which may be housed in a graphite moderated reactor is described. The tubular fuel elements are arranged within an enclosing tube through which a cooling fluid flows in the general direction of the axis of the tube. The tubular containers are disposed in rows. Each row is disposed at an oblique angle to those in adjacent rows, and all rows are at an oblique angle to the axis of the enclosing tube and aligned with each other in the direction of the axis. The enclosing tube is coaxially located in a further tube but spaced to permit the passage of cooling fluid between the two tubes. For a graphite moderated reactor the enclosing tube is also graphite. (N.W.R.)

24559 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. (to Siemens-Schuckertwerke A. G.). British Patent 870,315. June 14, 1961.

Thermal insulation for a moderator vessel and associated parts of a liquid moderated nuclear reactor is described. The insulation consists of a laminated structure adapted to be filled with the moderator and consisting of foils. The individual layers of the structure are spaced at such a distance apart that substantially no heat transmission can take place by convection in the moderator liquid situated between the layers. The foils are usually made of aluminum or zirconium and have a thickness of 0.1 mm. The laminated foil structure surrounds the coolant tubes of the moderator vessel. The layers are spaced apart by protuberances, prongs, or the like in the foil, while its outer end is secured to the preceding layer of foils by hooks. The boiler also contains within it the laminated foil structure with envelopes of slots or half-shells. (N.W.R.)

24560 METHOD OF AUTOMATIC REGULATION OF THE PERIOD OF NUCLEAR REACTORS. Pavel Kovanic

and Milan Kulka (to Zavody V. I. Lenina Plzen). British Patent 870,359. June 14, 1961.

A description of the method and the apparatus for automatically controlling the period of a reactor having a movable control rod to vary the output of the reactor is presented. The method and apparatus consists of a detector disposed in the radiation field of the reactor and movable along a path which is directed to provide radiation intensities which decrease approximately exponentially with increasing distance from the reactor. There is a servomechanism for moving the detector along the path. There are means for operating the servomechanism to effect movement of the detector at a predetermined constant speed. There is also a source of a constant demand signal and a reference circuit means substracting the output signal of the detector from the demand signal and producing a differential control signal corresponding to any difference between the output and the demand signals. There is also a servomechanism for moving the control rod of the reactor in response to the control signal so as to adjust the output of the reactor in the sense for equalizing the output signal of the detector with the demand signal, whereby the reactor period is made to correspond to the speed of the movement of the detector. (N.W.R.)

24561 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Ian Douglas Neilson (to Hawker Siddeley Nuclear Power Co., Ltd.). British Patent 870,891. June 21, 1961.

A nuclear reactor is described that contains a core of uranium fuel enriched with up to one per cent by weight of plutonium and an organic liquid acting as both coolant and moderator in an undermoderated lattice structure. The organic liquid is divided into two flows through the core, termed the coolant flow and the moderator flow. The coolant flow is in the immediate vicinity of the fuel and is faster than the moderator flows. The moderator is separated from the fuel by the coolant flow, and the volume of space occupied by moderator flow in the lattice is at least twice that of the coolant flow. The moderator is maintained at a temperature of about 200°C. The fuel is grouped into a plurality of assemblies of stainless steel tubes extending from top to bottom of the core. The coolant flow is separated from the moderator flow by an assembly tube of approximately hexagonal cross section containing each fuel assembly. (N.W.R.)

24562 IMPROVEMENTS IN NUCLEAR REACTORS. Frederick Henry Turner (to Babcock & Wilcox, Ltd.). British Patent 871,119. June 21, 1961.

The biological shield of a nuclear power reactor is described. The shield consists of a 2-ft inner upright wall of heat resistant concrete adapted to serve as a gamma attenuator. Most of the heat generated by gamma rays and neutrons is taken up by this wall. There is an outer 6-ft wall of concrete spaced from the inner wall by 3.5 ft. This void contains granular or finely divided material having a substantial gamma attenuation efficiency and acting as a heat insulator between the walls. (N.W.R.)

24563 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Robert Dorrell Collins (to United Kingdom Atomic Energy Authority). British Patent 871,726.

A carbon dioxide cooled reactor which provides means for comparing the general carbon monoxide content of the coolant with the carbon monoxide content of coolant emerging from selected channels is described. A fire may be detected by comparing the carbon monoxide content of the two samples. The reactor consists of a containment vessel, a moderator within the vessel, fuel element channels defined by the moderator, a multiselection valve, sampling pipes leading from the fuel element channels to the inlets of the multiselection valve, a differential infrared gas analyzer of the type having a reference tube and a sample tube, a pipe connection from the outlets of the valve to the sample tube of the infrared gas analyzer, a further sampling pipe from the containment vessel to the reference tube of the infrared gas analyzer, exit pipes from the sample tube and the reference tube, and a common pipe connecting with the exit pipes and the containment vessel. (N.W.R.)

24564 TELESCOPING FUEL ELEMENT ASSEMBLY FOR A NUCLEAR REACTOR AND OPERATING MEANS. James J. Dickson and Ernest Loeb (to Allis-Chalmers Mfg. Co.). British Patent 871,746. June 28, 1961.

The operation and design of a telescoping fuel element assembly for a nuclear reactor is described. The assembly consists of a plurality of sections, the outer end section is tubular in form and the other section carries a fuel box. The end section is connected by at least one intermediate section having a diameter permitting its telescopic association within the first end section. There are means extending laterally from the lower end of an intermediate section for engaging the lower end portion of the outer end section to engage the latter when the intermediate section is telescoped. All sections of the fuel assembly are removable by a lifting force applied to the intermediate section. (N.W.R.)

24565 NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). British Patent 871,897. July 5, 1961.

A description is given of a 1000-Mw heavy water moderated boiling reactor. The reactor consists of a pressure shell, a plurality of fuel elements disposed in a geometrical lattice arrangement submerged in a heavy-water coolant moderator within the pressure vessel, and control means. The control means operate in a manner to directly vary the percentage of vapor bubbles in the moderator. The disposition of the fuel elements within the moderator is suitable to yield a neutron multiplication factor greater than unity and a negative reactivity to the core void coefficient. The fuel elements are arranged in groups surrounding the control tube and they are supported by upper and lower grids. There are means for controlling the heavy water moderator in the control tubes. The fuel loading data, design data, and operating data are tabulated. (N.W.R.)

24566 NUCLEAR REACTOR. (to Rederiaktiebolaget Nordstjernan). British Patent 871,908. July 5, 1961.

A description is given of a thermal nuclear reactor with a core consisting of a moderator block of solid material with a plurality of channels in which there are arranged rods containing fuel and moderator material. Spaces between the rods and the channel walls are left for the passage of a cooling medium. The reactor is characterized in that 10 to 40% and preferably 20 to 30% of the total amount of the moderator material forms part of the rods. The fuel in each rod is surrounded by moderator material in good heat-conducting relationship. The remaining portion of the moderator material constitutes the moderator block. The fuel contained in each rod which is in the form of pellets is axially spaced and the rods are also axially spaced within the moderator. (N.W.R.)

24567 IMPROVEMENTS IN OR RELATING TO GAS COOLED NUCLEAR REACTORS. Stanley Hackney (to United Kingdom Atomic Energy Authority). British Patent 872,091. July 5, 1961.

A gas-cooled reactor is described particularly with attention being concerned with the withdrawal of the fuel elements. The pressure vessel contains a reactor core, fuel element channels orientated in the core, shielding for the core, access tubes projecting through the pressure vessel and shielding to give access to the fuel element channels, and a shield plug in each access tube. Each shield plug is connected to an assembly of at least one fuel element, whereby withdrawal of a selected shield plug from its normal position in the respective access tube causes withdrawal of the fuel element assembly from the core. Withdrawal of the shield plug is by employment of coolant pressure on a piston connected to the plug and associated with a detachable extension of the access tube. (N.W.R.)

24568 IMPROVEMENTS IN AND RELATING TO SAFETY RELEASE MECHANISMS. Stephen Baldwin Dunwich Fletcher and Deric Birkenshaw (to Nuclear Power Plant Co., Ltd.). British Patent 872,090. July 5, 1961.

A safety release mechanism for releasing a member from a parent member in response to changes in pressure in a fluid in which the releasable member is immersed is described. The device is particularly applicable to safety rods for nuclear reactors. The mechanism consists of a push rod attached to the releasable member and operable to trip a latch mechanism joining the releasable member to the parent member and a pressure sensitive device located in the releasable member and forming an enclosed space therein. The pressure sensitive device is responsive to pressure changes between the enclosed space and fluid surrounding the releasable member. The pressure sensitive device releases or trips the latch mechanism when a predetermined pressure change occurs. There may also be a temperature sensitive device operable on the same principal as the pressure sensitive device. (N.W.R.)

24569 IMPROVEMENTS IN NUCLEAR REACTORS. Michel Grenon, Louis Berthod, Georges Cohen De Lara, Michel Delachanal, and Georges Halbronn (to Commissariat a l'Energie Atomique). British Patent 872,476. July 12, 1961.

A description is given of a boiling liquid homogeneous reactor in which the fuel may be in the state of a solution or of a suspension. The reactor is characterized in that it comprises means which are adapted to produce a turbulent flow in a stationary core in such manner as to effect the separation of the vapor. This flow is accomplished by injection of fluid from at least one fluid injector in a tangential direction in relation to the envelope of the reactor. Thus the vapor is gathered into a funnel located substantially along the axis of revolution, from which the vapor is discharged. The core in this case acts both as a heat generator and as a vapor separator. (N.W.R.)

24570 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Graham Coates (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 872,719. July 12, 1961.

A unit fuel element assembly for a gas-cooled, graphite-moderated reactor is described. The assembly consists of an array of rectangular fuel plates in parallel planes extending obliquely to the vertical and spaced apart to permit coolant to flow between the fuel plates. The fuel plates are supported at opposite side edges in support plates which are at their upper and lower ends mounted on vertical struts in a manner to permit a limited amount of movement of the support plate and fuel plate assembly relative to the struts. Preferably the support plates are mounted on the struts by horizontal bars secured to the struts and carrying beveled washers which abut against correspondingly chamfered surfaces on the outer faces of the support plates. (N.W.R.)

24571 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Stanley Hackney and Ernest Edward Jerkins (to United Kingdom Atomic Energy Authority). British Patent 873,073. July 19, 1961.

A fuel element arrangement suitable for use in a gas-cooled nuclear reactor operating at 500 to 600°C is described. The fuel element consists of stacks of clusters of sheathed fuel members. The sheathed members are located at both ends in support plates in order that their weight is carried from one end and the other end is free to expand. There are spacers for the support plates such that the assembly of sheathed members, plates, and spacers forms a self-supporting body. There is a graphite sleeve supporting the body from one end and allowing expansion at the other end. (N.W.R.)

24572 IMPROVEMENTS IN OR RELATING TO TEMPERATURE CONTROL MEANS FOR NUCLEAR REACTORS. Sydney Fawcett (to United Kingdom Atomic Energy Authority). British Patent 873,074. July 19, 1961.

A temperature-sensitive restrictor valve for controlling the temperature of a graphite-moderated reactor is described. The restrictor valve consists of an operating member, a second operating member, the two members being secured together at a common end so as to be disposed adjacent one another. One operating member possesses a different coefficient of thermal expansion from that of the other, and the male and female members cooperate to provide a restriction for the aperture. The restriction is variable with the temperature of the fuel element coolant fraction to which the operating members are exposed due to differential expansion between the operating members acting to decrease the restriction on increase in temperature of the fuel element coolant fraction and thereby increase the size of the moderator coolant fraction relative to the fuel element coolant fraction, and vice versa. (N.W.R.)

24573 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR CONTROL INSTRUMENTATION. Robert Bruce and James Norman Evison (to Mullard, Ltd.). British Patent 873,108. July 19, 1961.

An emergency shut-down circuit for a nuclear reactor is described. The circuit includes an ion chamber responsive to the neutron flux level of a reactor, an a-c source for polarizing the chamber and providing a reference voltage, and means for comparing the output of the chamber with the reference voltage. The comparison is made by a bridge circuit including a pre-settable adjustment for ensuring an output from the bridge under normal reactor conditions and a null (or reversed) output under a reactor fault condition. (N.W.R.)

24574 IMPROVEMENTS IN AND RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Michael Carl Hartnell-Beavis (to General Electric Co., Ltd.). British Patent 873,112. July 19, 1961.

Fuel element arrangements for gas-cooled nuclear reactors, preferably where the moderating material is graphite, are described with the intent purpose of providing a means for obtaining good heat transfer conditions with low pressure losses and at the same time eliminating element supports. The moderator is formed with or providing at least one duct adapted for flow of the heat transfer medium. There are groups of fuel elements arranged across each duct in intervals in the direction of fluid flow. The fuel

elements are formed to give low resistance and may be streamline, oval, elliptical, or lenticular. The elements are supported by their ends only and are arranged in a series of rows with spaces being between elements in all directions except at the end supports. (N.W.R.)

24575 BOILING WATER REACTOR. R. Schulten (to Brown, Boveri). German Patent DAS 1 027 808. Aug. 4, 1956.

In order to reduce both the volume of and the absorption of slow neutrons by the water in a boiling-water reactor, blocks containing a mixture of beryllium oxide, thorium oxide, and uranium oxide are used. Water will not, in this case, be used as a moderator but only as a coolant. It is claimed its volume can be reduced by a factor 10. (EURATOM)

24576 SELF-SUSTAINING NUCLEAR REACTION BY MEANS OF NEUTRONS. (to Stichting Reactor Centrum Nederland). German Patent DAS 1 028 704. Apr. 24, 1958.

The fuel consists of a suspension of UO_2 in ordinary or heavy water, the size of the UO_2 powder being between 10 and 15 microns. The suspension circulates continuously through the reactor and its heat exchanger; it is freed from fission poisons by admixtures of activated carbon. Activated carbon is removed from the solution by a hydrocyclone. The average amount of activated carbon is 2 gram for each kilogram of UO_2. (EURATOM)

24577 MULTIPLE FUEL ELEMENT FOR NUCLEAR REACTOR. H. Kumpf (to Siemens). German Patent DAS 1 089 081. June 9, 1959.

Cylindrical fuel rods are held together in a bundle, laterally by a strip and at both ends by a grid on to which they are welded. One overall protective can serves for the complete bundle; it comprises built-in retaining rings. (EURATOM)

24578 STRUCTURE OF MULTIPLE FUEL ELEMENTS. H. Krŏpfl (to Siemens). German Patent DAS 1 093 500. May 22, 1959.

Each element consists of a bundle of rods held into position by superimposed spacing rings of appropriate shape. This shape allows the coolant to flow unhindered alongside the elements. (EURATOM)

Power Reactors

24579 (APAE-74(Vol.I)) SM-2 6000 & 12000 eKW NUCLEAR POWER PLANT PRIMARY SYSTEM DESIGN. (Alco Products, Inc., Schenectady, N. Y.). June 1, 1961. Contract DA-44-192-ENG-7. 399p.

The development studies for an SM-2 Nuclear Power Plant primary system are summarized. The studies include the following: horizontal steam generator, safety and alarm system, decontamination methods, waste disposal, preassembly and packaging, vapor container, vertical steam generator and feedwater control system, pressurizer development and design studies, fuel handling, superheater, and instrumentation. The design analysis for the main primary system and the primary auxiliary system is given and includes calculations, sketches, and descriptions. The results obtained from the development studies and design analysis are included for a 6000 kw(e) plant design which utilizes a single 28 Mw(t) reactor system, and for the preliminary design of a 12,000 kw(e) plant design which utilizes two identical 28 Mw(t) reactor systems. (auth)

24580 (APAE-74(Vol.2)) SM-2 6000 & 12000 eKW NUCLEAR POWER PLANT PRIMARY SYSTEM DESIGN ANALYSIS CALCULATIONS. (Alco Products, Inc., Schenectady, N. Y.). June 1, 1961. Contract DA-44-192-ENG-7. 307p.

The design analysis calculations of the SM-2 6 and 12-Mwe nuclear power plant primary system are presented as a companion volume to Volume I. (D.L.C.)

24581 (APAE-74(Vol.3)) SM-2 6000 eKW (NET) NUCLEAR POWER PLANT FINAL DESIGN SECONDARY SYSTEM. (Alco Products, Inc., Schenectady, N. Y.). June 1, 1961. Contract DA-44-192-ENG-7. 360p.

A design analysis study of the SM-2 secondary plant equipment was undertaken to develop an SM-2 final design. Equipment sizes are based on utilization of a 28 Mw(t) pressurized water reactor and a 7500 kw(e) turbo-generator. Drawings showing equipment arrangement and over-all plant layout are provided. Studies were made of mechanical, structural, and electrical design and all calculations are given. (auth)

24582 (APAE-74(Vol.4)) SM-2 12000 eKW POWER COMPLEX NUCLEAR POWER PLANT SECONDARY SYSTEM DESIGN. (Alco Products, Inc., Schenectady, N. Y.). June 1, 1961. Contract DA-44-192-ENG-7. 213p.

A design analysis of the secondary system of the SM-2 12,000-ekw (net) power complex, nuclear power plant, final design is presented. Studies of the mechanical, structural, and electrical engineering designs were performed. Equipment sizes are based on using two 28-tMw pressurized water reactors and five 5000-kva generators, with four normally operating at $^3/_4$ load. Drawings, showing equipment arrangement and over-all plant layout, and calculations were prepared prior to June 30, 1960. The drawings and design analysis are not complete but will be used as the basis of the final design of the SM-2 12,000 kw(e) (net) power complex. (auth)

24583 (APAE-86) ARMY PWR SUPPORT AND DEVELOPMENT PROGRAM. MID-YEAR SUMMARY REPORT, OCTOBER 1, 1960 – MARCH 31, 1961. (Alco Products Inc., Schenectady, N. Y.). June 2, 1961. Contract AT(30-1)-2639. 150p.

A cyclic stress analysis of the SM-1 primary system was carried out. Problems encountered in the fabrication of PM-2A Core II and SM-1A Core II are described, and the results of an examination of damaged SM-1A Core I stationary fuel elements reported. A preliminary study of the radiation damage to SM-1 reactor vessel was made and the possibility of annealing the vessel discussed. Performance analyses are presented for five cores: SM-1 Core, SM-1 Core I rearranged and spiked, SM-1 Core II with special components, PM-2A Core I, and SM-1A Core I. Preliminary critical experiments were made with SM-2 elements in a SM-1 core configuration and nuclear and thermal analyses of the use of SM-2 elements in SM-1, SM-1A, and PM-2A completed. A throttling steam calorimeter was selected for measuring moisture carry-over on the PM-2A steam generator. Test procedures for evaluating the shielding of the SM-1, SM-1A, and PM-2A plants are summarized. Radiochemical and chemical analyses of SM-1 coolant and crud are summarized, and methods of activity control discussed. Preliminary results of studies of the properties of reactor pressure vessels under irradiation and nonirradiation conditions are summarized briefly. (D.L.C.)

24584 (APAE-Memo-291) INTERIM REPORT ON THE USE OF SM-2 ELEMENTS IN SM-1, SM-1A AND PM-2A CORES. S. L. Davidson and J. P. Oggerino (Alco Products, Inc., Schenectady, N. Y.). June 20, 1961. Contract AF(30-1)-2639. 90p.

Interim results of an analytical investigation of nuclear and thermal characteristics of SM-2 type fuel elements in SM-1, SM-1A, and PM-2A reactor cores are reported. Utilizing modified two-group diffusion theory, predictions of power distribution and core and rod reactivity were performed. The calculations indicate that use of SM-2 fuel elements in SM-1, SM-1A, and PM-2A is feasible from the nuclear standpoint. A steady state thermal analysis of each plant utilizing SM-2 elements was carried out. This analysis showed that the minimum departure from nuclear boiling ratios were considerably above the minimum value from the design criteria standpoint at both the operating and scram power levels. The investigation indicated that SM-2 elements can successfully be employed in SM-1, SM-1A, and PM-2A as replacement core elements. (auth)

24585 (BAW-1208) NUCLEAR MERCHANT SHIP REACTOR EXTENDED ZERO POWER TESTS BRIDGING EXPERIMENTS. M. L. Batch, R. M. Ball, A. L. MacKinney, and J. H. Mortenson (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). May 1961. Contract AT(30-1)-2534. 72p.

Laboratory physics equivalents were constructed for the fuel container and control rods of the Nuclear Merchant Ship Reactor. Tests with Core I fuel showed the Laboratory Core to have $0.74 less excess reactivity and 4.7% more rod holddown power than the Service Core. The cores had identical temperature coefficients, but the Laboratory Core displayed a flux pattern with 11% smaller peaking factors. (auth)

24586 (BNL-670) EVALUATION OF INTERNAL PRESSURIZATION FOR APPLICATION TO PRESSURIZED WATER REACTOR SYSTEMS. K. C. Hoffman and J. McNicholas (Brookhaven National Lab., Upton, N. Y.). Apr. 26, 1961. 13p.

Internal pressurization has been proposed as a method of reducing the cost of power from pressurized water reactors. Two methods of internal pressurization are discussed and evaluated. Self-pressurization, which involves operation with the reactor exit coolant at saturation temperature, does result in decreased power costs, due mostly to the increased cycle efficiency and net electrical output associated with the higher operating temperature of the self-pressurized plant. Other schemes, involving mechanical changes rather than changes in operating conditions, are also evaluated and shown to be marginal, offering no significant economic incentive. (auth)

24587 (CEA-1782) DEUX NOUVELLES ANNEES DE FONCTIONNEMENT DU REACTEUR G 1 (JUILLET 1958–JUILLET 1960). (Two Further Years of Operation of the Reactor G1 (July 1958–July 1960). O. Mathot, J. Bauzit, R. Cante, and L. Hebrard (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, France). 1960. 53p.

This is a continuation of report CEA-950 (A/Conf.15/P/1132).

At the end of the annealing, the thorium lattice was modified and extra thermocouples were installed for measuring the temperature of the body of the graphite. An apparatus was built for measuring the radial flux. A continuous operation campaign with a minimum of stoppages was performed next. The experimental results are reassembled, independently of their chronological order, under three main headings which describe the reactor history; continuous operation, discharges, and annealing of the reactor. (auth)

24588 (GNEC-116) GAS-COOLED REACTOR PROJECT PROGRESS REPORT NO. 5, APRIL 2, 1959 TO OCTOBER 9, 1959. (General Nuclear Engineering Corp., Dunedin, Fla.). Oct. 15, 1959. 184p. For East Central Nuclear Group and Florida West Coast Nuclear Group.

Modifications and refinements to the reference design made during the period are reported. The number of pressure tubes in the prototype reactor was increased from 178 to 208. The refueling machine will be located beneath the tube array and the fuel will be handled from the bottom of the reactor. Control rods will enter the core on two sides. A reference bundle design was selected and fabrication of test bundles for in-pile and out-of-pile testing was started. After 3000 hours in the corrosion test loop, type-347 stainless steel showed promise of being a satisfactory cladding material. Investigation of Al–Cr–Fe alloys for use as cladding materials was continued, and tests to evaluate materials for use in other parts of the system are progressing. These tests are designed to determine the effects of gas velocity, pressure, and moisture on corrosion. Preliminary data on heat transfer coefficients were obtained from the heat transfer loop. Stress coat tests served as a check on analytical calculations of stress. A gas flow test loop was assembled and operated; it will be used to determine pressure drop in the reactor piping system. (J.R.D.)

24589 (LAMS-2526(p.214-17)) RADIATION DOSE RATE MEASUREMENTS FROM THE KIWI-A SERIES OF NUCLEAR REACTORS. D. L. Williams (Los Alamos Scientific Lab., N. Mex.).

Measurements were made of γ and fast neutron dose rates during tests of the Kiwi-A series of prototype rocket propulsion nuclear power units. A system of paired liquid scintillator photodetectors capable of measuring the dose rates of γ and fast neutron components in a mixed field were used. Design modifications and performance of the detectors are discussed. (C.H.)

24590 (PRDC-TR-44) MONTHLY TECHNICAL REPORT, REPORT PERIOD–FEBRUARY 1961. (Power Reactor Development Co., Detroit). Contract AT(11-1)-476. 14p.

Research and development on the Fermi Fast Breeder Reactor are summarized in sections concerned with core design, materials and metallurgy, nuclear engineering, mechanical handling, instrumentation, liquid metal and steam systems, and test operations. (J.R.D.)

24591 (SRO-50) HEAVY WATER POWER REACTOR PROGRAM. Monthly Progress Report, June 1961. (Savannah River Operations Office, AEC). 18p.

The current status of the D_2O power reactor development activities is outlined. Some of the items discussed are: research and development carried out by various agencies, the Heavy Water Components Test Reactor, and the Power Demonstration Program. (D.L.C.)

24592 (TID-3556(Rev.1)) SELECTED REACTORS OF THE POWER REACTOR DEMONSTRATION PROGRAM. A Literature Search. James M. Jacobs; comp. (Office of Technical Information Extension, AEC.). June 1961. 52p.

A bibliography of 552 reports is presented on eleven reactors of the Power Reactor Demonstration Program. The reactors are the Big Rock Point, Elk River, Enrico Fermi, Florida, Hallam, Parr Shoals, Pathfinder, Peach Botton, Piqua, Puerto Rico, and Yankee power reactor. (D.L.C.)

24593 (TID-7611) PROCEEDINGS OF HIGH TEMPERATURE GAS-COOLED CIVILIAN POWER REACTOR CONFERENCE, JANUARY 17-18, 1961. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). 197p.

Twelve papers presented at the High Temperature Gas

Cooled Civilian Power Reactor Conference are given. The 40-Mw Prototype High Temperature Gas Cooled Reactor. HTGR nuclear design, engineering analysis, experimental physics, experimental metallurgy, chemistry, engineering design, reactor equipment, fluid systems, safeguards analysis, shielding, and instrumentation and control are discussed. (M.C.G.)

24594 (TID-13079) EVALUATION OF SOLID FILM LUBRICATED AND UNLUBRICATED GEARS IN DRY HELIUM ATMOSPHERE. Final Report. (Report No. 614-137). D. J. Fessett (Western Gear Corp., Lynwood, Calif.). Apr. 30, 1961. For Kaiser Engineers. Contract AT(10-1)-925, Subcontract 5918-RD-4. 34p.

Evaluation of dry films for application on spur gears for servicing components of a gas-cooled nuclear reactor was performed. Commercial dry film lubricants were screened in wear tests to obtain the optimum lubricant which was in turn used in gear tests. A MoS_2, graphite, and sodium silicate binder lubricant (Everlube 811 or equivalent) applied to M 50 tool steel gears resulted in the optimum combination based on stress cycle tests. Tests were performed on unlubricated worm gears at simulated loads, speeds, and environment of the charging machine for the above reactor to determine wear rates and efficiencies. (auth)

24595 (TID-13105) TITLE II FUEL ASSEMBLY HANDLING EXPERIMENT FOR THE EXPERIMENTAL GAS COOLED REACTOR. P. J. Lain (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Feb. 23, 1961. Contract AT(10-1)-925. 125p. (RD-0101)

Tests were performed on the final fuel assembly configuration for the EGCR to determine its capability to withstand handling procedures associated with reactor operation. The tests included those for shipment and packaging, manual handling, anvil impact, stationary sleeve impact, assembly cycling, and transfer tube latch. The results of the tests are given. (D.L.C.)

24596 (WAPD-PWR-TE-114) PERIODIC CALIBRATION OF TEMPERATURE SENSING ELEMENTS, REACTOR PLANT PORTION. TEST EVALUATION T-641303, DLCS-2430110 [PERFORMED APRIL 1 TO 3, 1961]. James G. Evans (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). 1961. Contract AT-11-1-GEN-14. 6p.

Attached to this report is a letter (WAPD-PWR-S(A)-518) containing pertinent data from R. F. Stratton, dated May 29, 1961. 2p.

An evaluation was made of the reactor plant protion of DLCS 2430110 performed on April 1 to 3, 1961. The results indicate satisfactory calibration of reactor plant temperature measuring instrumentation. However, a drift of +11.5°F was noted for the 1A wide-range T_h detector. (D.L.C.)

24597 (NP-tr-661) AIRCRAFT NUCLEAR POWER PLANTS. (Atomnye Aviatsionnye Dvigateli). Ya. Yu. Malodorskii (Malodorskiy) and E. V. Rovinskii (Rovinskiy). Translated from Chapter I, p.29-32 of "Osnovy Termodinamiki i Gazovoi Dinamiki," Moscow, 1960. 5p.

The series of structural, technological, and operational difficulties which occur during the utilization of a nuclear reactor in aircraft engines are discussed. The nuclear turbojet engine and its differences from the ordinary turbojet are described. The weight and size of the nuclear aircraft engine and methods of reducing them are discussed. (M.C.G.)

24598 (NP-tr-687) NUCLEAR REACTOR AS THE OBJECT OF CONTROL. [AUTOMATIC CONTROL OF AIRCRAFT ENGINES]. Collection of Articles. (Avtomaticheskoe Regulirovanie Aviadvigatelei. Sbornik Statei. p.66-106). A publication of the State Scientific-Technical Publishing House, Moscow, 1960. 52p.

The dynamics of a power reactor is treated in some detail. Although the reactor is described by a nonlinear differential equation of the seventh order, a two-group approximation with prompt neutrons and one averaged group of delayed neutrons may be used. When the reactor is in equilibrium, the reactor equation may be linearized in two ways. The effects of positive and negative coefficients of reactivity on reactor operation and the frequency properties of the reactor are discussed. The nonlinear character of the control rods is treated. (D.L.C.)

24599 THE SIGNIFICANCE OF BASIC NUCLEAR DATA FOR REACTOR TECHNOLOGY. K. H. Beckurts (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirtschaft, 6: 317-20(June 1961). (In German)

The determination of the reactor parameter in the construction of a reactor installation cannot, especially for advanced concepts, be made sufficiently accurately using the so-called "semiempirical methods" alone but must be carried out from the basic nuclear data for the fuel and structural materials using multi-group methods. An intensification of nuclear data research through increased international cooperation appears important for reactor technology. (auth)

24600 SOME CIVIL ENGINEERING ASPECTS OF THE CANADA INDIA REACTOR PROJECT. V. R. Vengurlekar (Atomic Energy Establishment, Trombay, India). Ind. India, Atomic Energy Suppl., 36-7(Jan. 1961). (In English)

Civil engineering aspects of the construction of the Canada India Reactor (CIR) are reviewed. The CIR is a natural U, heavy water moderated, light water cooled research reactor. The reactor site is near the sea and as much as 14 ft below sea level, necessitating waterproofing of foundations. Measures and testing procedures to insure water- and air-tightness, concrete specifications, and form work for the 400-ft effluent stack are discussed. (T.F.H.)

24601 ELECTRIC POWER FROM NUCLEAR HEAT—DIRECT. J. W. Gardner (English Electric Co., Ltd., Whetstone, Leicester, Eng.). Nuclear Energy, 237-42 (June 1961).

The direct conversion of heat to electricity is studied. Thermoelectric-conversion fundamentals and practical aspects are studied, including uses of semiconductors in thermopiles, fabrication and assembly of thermopile materials, nuclear applications, and system efficiencies under direct and indirect heating. Aspects of thermionic conversion, such as electrode temperatures, work functions, efficiencies, and interelectrode plasma effects are studied. Incorporation of thermopiles and thermionic cells into reactor fuel elements is discussed. Properties of magnetohydrodynamic conversion cells and fuel cells are noted. (T.F.H.)

24602 BURST SLUG DETECTION IN THE AGR. David Iggulden. Nuclear Power, 6: No. 61, 71-3(May 1961).

The burst slug detection system for the Windscale Advanced Gas Cooled Reactor is described. Since there are 253 fuel channels in the reactor, monitors are grouped in a 16 × 16 matrix to reduce their number. The system is set up so that the precipitators continuously monitor the channels and the position of a burst is shown by lights on a panel replica of the core. The controls of the system

provide variation in count and soak times and indicate any faults in the system. The equipment used is also discussed. (N.W.R.)

24603 REFUELLING THE AGR. J. Spencer Burkett. Nuclear Power, 6: No. 61, 75-7(May 1961).

The design and characteristics of the Windscale Advanced Gas Cooled Reactor refueling machine are presented. The machine is designed for positioning automatically over any of the 253 tubes to within 0.005 in. The machine is independent of all extraneous mechanical aids and will travel the full floor width of the containment building. In addition to working under the normal conditions of full load and pressure, facilities are available for inspection and maintenance during shut-down. The 65-ft-high machine has a working pressure (on load) of 280 lb/in.^{2} and is designed to operate at 325°C. (N.W.R.)

24604 THE SIMULATION OF THE MACROECONOMIC PROBLEM OF KALECKI-KEYNES AND THE ECONOMICS OF NUCLEAR INSTALLATIONS. Gian Paolo Caligiuri [(Università, Rome)]. Riv. ing., No. 2, 6p.(Feb. 1961). (In Italian)

The fundamental statement of the macroeconomic dynamic system of Kalecki as modified by Keynes is simplified mathematically and the electronic theory of the analog network is discussed. The discussion concludes with remarks on nuclear thermoelectric plants. (T.R.H.)

24605 DESIGN OF A NUCLEAR CENTER FOR LOCAL HEATING, OF 30,000 kW THERMAL POWER. Riv. ing., 10: 157-9(Feb. 1961). (In Italian)

A 30 Mw (thermal) Italian nuclear power plant is described that is used for urban heating purposes. A heavy water moderated and cooled, slightly enriched U reactor is used as the heat source. A three stage heat exchanger system is employed. The entire plant is located in a cavern. (T.F.H.)

24606 THE PLASMA CORE REACTOR. Seymour T. Nelson (Aerospace Corp., El Segundo, Calif.). [Paper No.] 1734-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 118p.

Two types of plasma core reactor, considered as space propulsion systems of thrust-to-weight ratio exceeding unity, are investigated. The systems studied are the simple magnetic bottle and the homopolar configurations. The principal system variables are indicated, and some upper and lower bounds for these are derived. The major problem areas and difficulties affecting feasibility are discussed. (auth)

24607 THE VORTEX MATRIX APPROACH TO GASEOUS NUCLEAR PROPULSION. M. L. Rosenzweig (Aerospace Corp., Los Angeles). [Paper No.] 1735-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 20p.

The fluid mechanical problems involved in the development of a vortex reactor for nuclear rocket applications are reviewed. In particular, the influence of turbulence on containment is analyzed and the origins of turbulence in jet-driven vortices are investigated. The vortex matrix concept is introduced as a means of reducing the turbulence levels at high pressures. The matrix consists of a number of vortices generated in a single container such that adjacent vortices "roll" on one another. The matrix reduces turbulence in two ways. Turbulent boundary layers on the cylindrical walls of individual vortex tubes are eliminated by the elimination of solid boundaries between adjacent vortices in the matrix configuration. Reduction of the wall area per vortex leads to smaller momentum losses and thus to increased jet velocity recovery. This reduction in turn reduces the turbulence introduced by the injection jets. (auth)

24608 NUCLEAR SPACE POWER SYSTEMS UTILIZING MAGNETOHYDRODYNAMIC VORTICES. W. S. Lewellen and W. R. Grabowsky (Aerospace Corp., El Segundo, Calif.). [Paper No.] 1738-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 24p.

A magnetohydrodynamic vortex is proposed as a conversion mechanism for a Rankine-cycle electric power system using a nuclear reactor as the energy source. Fundamental relationships existing between the various parameters of the magnetohydrodynamic vortex are presented and discussed, and certain design considerations relative to the working fluid and fabrication materials are given. The system's performance is compared to a similar system using a mechanical turbo-alternator for conversion. The chief advantage of the magnetohydrodynamic vortex is that it is designed to operate at considerably higher temperatures than a high speed turbine, permitting the over-all temperature level of the system to be raised accordingly. This yields a weight reduction of the order of 50% or more for systems with power levels of 100 kw and higher. (auth)

24609 HAZARDS ASSOCIATED WITH NUCLEAR POWER REACTORS IN SPACE APPLICATIONS. P. G. Lafyatis (Oak Ridge National Lab., Tenn.). [Paper No.] 1754-61. Presented at "Space-Nuclear Conference, May 3-5, 1961, Gatlinburg, Tennessee." New York, American Rocket Society. 9p.

General principles of reactor hazards evaluation are discussed relative to their application to space reactors. Potential hazards of space reactors are compared to those for small stationary nuclear plants, and the differences between them are discussed, particularly with respect to the probability of fission-product dispersal and consequent effects on the general public. Quantitative conclusions are only possible when an actual reactor is chosen. The hazards for the first-generation space reactors of power less than 1 Mw, which implies a small fission-product inventory, can be kept small. The lowest hazard potential for large first-stage booster nuclear rockets is given by highly reliable and recoverable reactors shot from remote locations. (auth)

24610 NUCLEAR REACTOR FOR THE GENERATION OF ENERGY FROM FISSILE ELEMENTS. (to Shell Internationale Research Maatschappij N. V.). British Patent 872,075. July 5, 1961.

A nuclear reactor for the generation of energy from fissile elements is discussed. A circulating stream of an organic liquid is used as the heat transfer agent. The organic liquid consists of an aromatic extract of a catalytically cracked oil. The aromatic extract is obtained by means of an extraction using furfural as the selective solvent. The oil is refined by catalytic treatment with hydrogen at 25 to 75 atm and at 350 to 400°C in the presence of a catalyst of cobalt oxide and molybdenum oxide supported on alumina. Before refining the cycle oil it is diluted with a light hydrogen fraction such as naphtha. (N.W.R.)

Research Reactors

24611 (GEAP-3040) CER STARTUP EXPERIMENTS. D. L. Fischer (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). July 1958. 23p. (VAL-88)

The results of a series of start-up experiments per-

formed at the Lockheed CER during the period June 4 to 18, 1958 are presented. The purpose of the experiments was to demonstrate the satisfactory nuclear characteristics of this reactor. The following reactor characteristics were measured: critical loading, operational loading, temperature coefficient, average void coefficient, regulating rod strength, and control system strength. These results were in good agreement with the design characteristics predicted before start-up. (auth)

24612 (HW-62111) PRTR HIGH PRESSURE LOOP HAZARDS SURVEY OF PRELIMINARY SCOPE DESIGN. J. K. Anderson and P. C. Walkup (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 15, 1959. Contract AT(45-1)-1350. 58p.

A high-pressure loop is being designed for insulation in the Plutonium Recycle Test Reactor. The loop is designed for studies of the feasibility of reactor cooling systems using supercritical-pressure steam and high-pressure superheated steam as coolants. Internally, and/or externally cooled fuel elements generating up to 900 kw are to be tested in the loop. The light-water coolant is to be pressurized to 4500 psia with maximum coolant temperatures of 950°F at the fuel inlet and 1050°F at the fuel outlet. Analysis of the preliminary scope design revealed no adverse effect on the nuclear safety of the PRTR. Insertion of presently contemplated test sections will require the additional charging of no more than one spike enrichment fuel element to compensate for the poisoning effect of the test section. Adequate safety features which were incorporated into the design are: electric power backup, emergency cooling water injection, reactor safety circuit trips, and water cooled sleeve system for containing the fuel element in the event that it fails. Conceivable accidents, e.g., rupture of the high-pressure system piping combined with fuel element rupture, could result in the release of fission products from the loop. However, fission products released would be confined within the PRTR containment vessel. Radiation dosage from material confined in the containment vessel or from leakage from the containment vessel, at maximum expected rates, would be minimal. (auth)

24613 (JAERI-1019) ON CRITICAL MASS ANALYSIS OF JRR-2. (Japan Atomic Energy Research Inst., Tokyo). 1961. 28p.

The critical mass of the JRR-2 was found to be 15 fuel elements, instead of 8 as expected, when the reactor reached criticality. The critical mass was analyzed by AMF and JAERI a few years ago, but afterwards some modifications have been made of the structure for the reinforcement, for example, during the construction. The critical mass is recalculated perfectly and the difference between 15 and 8 fuel elements is discussed. The deviation of the critical mass is mainly caused by the effects of control rods, fuel elements, grid-plate, etc., in the reflector; only heavy water or light water was considered as the reflector in the previous calculation. A simple method is used to calculate the critical mass. The effective multiplication factor for the core with 15 fuel elements is obtained about 2% higher than the experimental value. This difference is also discussed in detail. (auth)

24614 (LAMS-2526(p.355-63)) NEUTRON FLUX, SPECTRUM, AND TISSUE DOSE EVALUATIONS FOR THE SANDIA PORT OF THE OMEGA WEST REACTOR FACILITY. J. A. Sayeg (Los Alamos Scientific Lab., N. Mex.).

A survey was made of the neutron flux, spectrum, and tissue dose for the Sandia port of the Omega West Reactor. Preliminary neutron data are presented. (C.H.)

24615 (JPRS-8422) THE POLISH ATOMIC REACTOR EWA AT SWIERK. Tadeusz Berens. Translated from Przeglad Mech. 19: No. 17, 510-16(Sept. 10, 1960). 19p.

The Polish Atomic Reactor at Swierk is described. The reactor was designed to produce thermal neutrons for research purposes. Included in the description are fuel and core, vertical reactor channels, the reactor tank, concrete shielding of the tank, horizontal channels and thermal column, rotating covers, loading devices, primary water circuit, auxiliary technological devices, and hot cells. (M.C.G.)

24616 APSARA, INDIA'S FIRST REACTOR. R. Ramanna and N. Sarma (Atomic Energy Establishment, Trombay, India). Ind. India, Atomic Energy Suppl., 25-8(Jan. 1961). (In English)

The design and development of the Indian reactor APSARA are outlined. The reactor is a light water swimming pool reactor, with Al–U alloy fuel elements that are enriched to 40% U^{235}. The safety and control, research, isotope production, materials testing, and other facilities of the reactor are considered. (T.F.H.)

24617 ZERLINA. N. B. Prasad and N. Lakshmanachar (Atomic Energy Establishment, Trombay, India). Ind. India, Atomic Energy Suppl., 29-31(Jan. 1961). (In English)

The Indian ZERLINA low power (<100 w), heavy water moderated, natural U, changeable lattice research reactor is described. The reactor structure and matrix configurations, shielding and safety systems, heavy water purification and recovery facilities, operation and control procedures, and design features are discussed. The reactor is designed for lattice parameter and lattice optimization experiments, oscillation experiments, and danger coefficient experiments. (T.F.H.)

24618 INSTRUMENTATION FOR A SUBCRITICAL HOMOGENEOUS SUSPENSION REACTOR. II. MEASUREMENT AND CONTROL OF OPERATING PARAMETERS. B. L. A. van der Schee and M. van Tol. Philips Tech. Rev., 21: 121-33(1959/60). (In English)

Methods and equipment employed in determining and controlling temperatures and fuel concentrations in the Arnhein suspension reactor are described. Diagrams and flow charts are included. (D.E.B.)

24619 THE CANADA INDIA REACTOR. [Trombay, India, Atomic Energy Establishment and Chalk River, Ont., Atomic Energy of Canada Ltd., 1961]. 25p.

A review of the Canada India Reactor (CIR) is presented. The CIR is a natural U, heavy water moderated, light water cooled swimming pool reactor. The reactor housing, structure, cooling, fuel, control, and research facilities are outlined. Fuel element storage, handling, and cutting facilities are described. (T.F.H.)

WASTE DISPOSAL AND PROCESSING

24620 (HW-SA-2198) MINERAL REACTIONS, A NEW WASTE DECONTAMINATION PROCESS. J. F. Honstead, L. L. Ames, Jr., and J. L. Nelson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 24, 1961. Contract AT(45-1)-1350. 14p.

Mineral reactions are discussed as a means of solving the containment problem for some radioactive wastes. The reactions may be classified into two types: (1) replacement (precipitation) reactions and (2) adsorption reactions on mineral surfaces. Examples of each type are given. (D.L.C.)

24621 (NYO-7830) RADIOACTIVE WASTE DISPOSAL PRACTICES IN THE ATOMIC ENERGY INDUSTRY. A Survey of the Costs. Arnold B. Joseph (Johns Hopkins Univ., Baltimore). Dec. 31, 1955. Changed from OFFICIAL USE ONLY Mar. 23, 1961. Contract AT(30-1)-1477. 202p.

A survey was made on methods and related costs of disposing of radioactive wastes as practiced in 1955 by twelve atomic industry installations. Wherever possible, estimated unit costs of differentiated stages of waste handling are shown; these are integrated to show the over-all scope of waste disposal practices at each site. Tabular data summarize costs and operation magnitudes at the installations. A pattern is established for standardizing the reporting of fixed costs and equipment usage costs. The economy of solid waste volume reduction is analyzed. Material costs are listed. An outline for recording monthly waste disposal costs is presented. Obvious conclusions drawn from the factual data are: that it is more expensive per cubic foot to handle high-level wastes than low-level wastes; and that land disposal is less expensive than sea disposal. A reexamination of baling economics shows that high compression of solid wastes is more expensive than simpler forms of compaction. (auth)

24622 ONE- AND TWO-STEP COAGULATION TREATMENT OF RADIOACTIVE WASTES. Takehiko Ishihara, Noriyuki Mishio, Shozo Kadoya, and Yutaka Yamamoto (Japan Atomic Energy Research Inst., Tokyo). J. At. Energy Soc. Japan, 3: 353-9(May 1961). (In Japanese)

The removal of long-life fission-products, especially Cs^{137}, Sr^{90}, and Ru^{106}, was studied using jar-testers and slurry recirculation type flocculators. Bentonite-polyelectrolyte coagulation was found most effective for Cs^{137} removal, phosphate coagulation for Sr^{90} removal, and sulfide coagulation for Ru^{106} removal. All coagulants employed removed Ce^{144} and Zr^{95}. Removal of contaminants from mixtures of Cs^{137}, Sr^{90}, and Ru^{106} improved by two-step coagulation with a combination of bentonite-polyelectrolyte and a phosphate and/or sulfide. Phosphate coagulation followed by bentonite-polyelectrolyte coagulation gave best results. The slurry recirculation type flocculator removed contaminants using smaller quantities of chemicals than the jar-tester. Various processes were applied to reduce the volume of sludge produced by coagulation, and a freezing treatment was found to reduce the volume to 1% or less of the original waste volume. (auth)

24623 ON THE DE-ACTIVATION (DECONTAMINATION) OF RADIOACTIVELY CONTAMINATED WASTE WATERS. Bernard Marchand (Universität, Freiburg, i.B.). Kerntechnik, 3: 193-200(May 1961). (In German)

Methods are discussed for achieving as complete a separation of the radioactive components as possible. The most important methods are explained in reference to their theoretical foundations: distillation, filtration, chemical precipitation, absorption precipitation, and treatment with ion exchangers. The possibilities of a combination of such methods are discussed. (auth)

24624 NATURAL RADIOACTIVITY AND THE WASTES OF SACLAY. Jean Debiesse (Centre d'Etudes Nucléaires, Saclay, France). Nucleus (Paris), No. 1, 50-4(Jan.-Feb.). (In French)

The natural radioactivity found in the air, ground, and waters and in man is summarized. The radioactivity that the Saclay nuclear laboratory adds to the natural activity is then discussed. (J.S.R.)

24625 NUCLEAR ENERGY INDUSTRIAL WASTES. Joseph A. Lieberman and David C. Costello, Jr. (U. S. Atomic Energy Commission, Washington, D. C.). Univ. Illinois Circ. 58: No. 83, Eng. Expt. Sta., Circ, No. 69, 20-7(July 1961).

A summary is given of public hearings held last year before the Special Subcommittee on Radiation of the Joint Committee on Atomic Energy. The summary concerns the treatment and disposal of two classes of radioactive wastes: low- and high-level. Particular attention is given to the disposal of high-level wastes. Gaseous and airborne, solid, and liquid wastes are each discussed separately. (P.C.H.)

24626 IMPROVEMENTS IN OR RELATING TO THE SHIELDING OF RADIOACTIVE LIQUID MASSES. Ernest William Sidebotham (to United Kingdom Atomic Energy Authority). British Patent 871,665. June 28, 1961.

A method is described for shielding the surface of a radioactive liquid exposed to the atmosphere. The method consists of constantly applying to the surface of the liquid mass a layer of liquid in a laminar manner, the applied liquid being at a higher temperature than that of the liquid of the mass. The applied liquid is the same as the liquid mass. An anti-evaporation layer is applied to the constantly applied layer of liquid to prevent exposure of the applied layer to the atmosphere. The anti-evaporation layer is liquid paraffin B.P. A description of the cooling pond and associated equipment for storing the radioactive material is given. (N.W.R.)